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The Outdoors

Studies for Open Places

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The Outdoors

Studies for Open Places

Ryerson Science in Action

The Outdoors

Studies for Open Places

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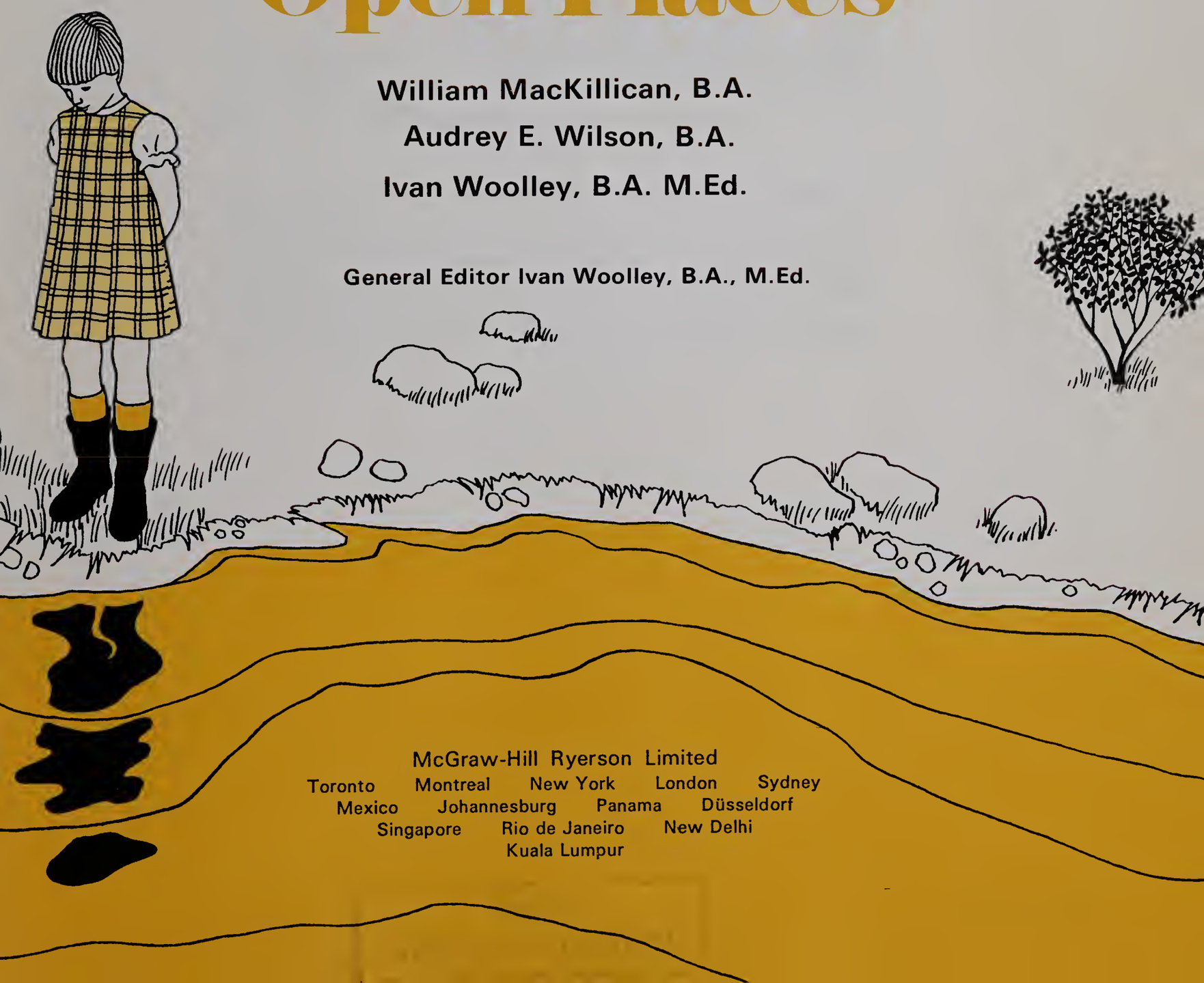

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The live animal trap on pages 46 and 47 is reproduced by permission of Mr. O. Rogers, and Mrs. Frank Pammett kindly made available the work of her late husband, whose research and ideas have been adapted for children of elementary school age.

W.S.M. A.E.W. I.A.W.

Ivan Woolley and William MacKillican are Canadian public school principals and are widely experienced in outdoor science teaching. Miss Wilson, an expert naturalist and nature photographer, is Director of an outdoor science school.

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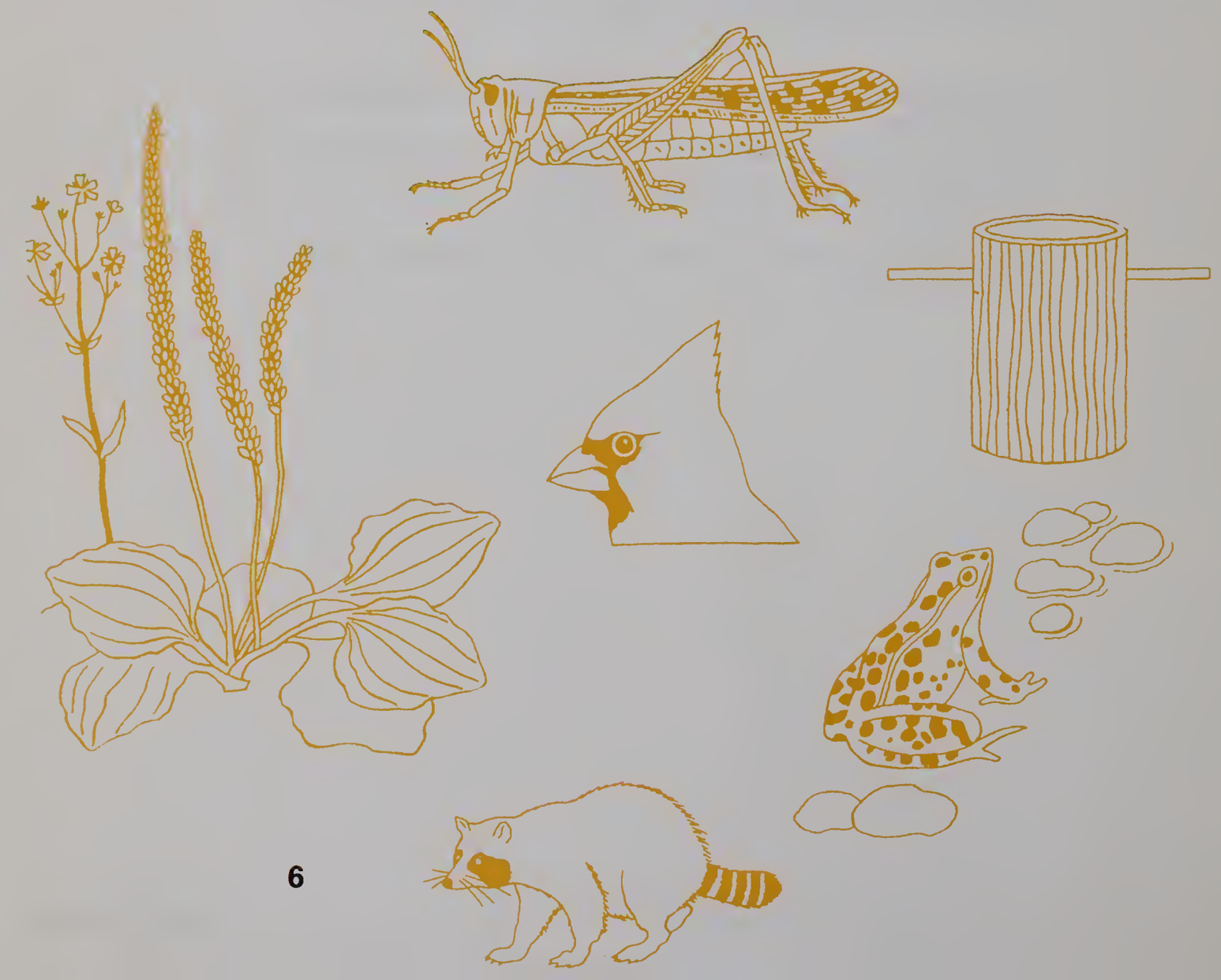
CONTENTS

	Page
Acknowledgments	5
To the Teacher	8
Suggestions for Mapping	11
Hints for Sampling	14
Use of Binoculars	20
To the Pupil	21



Birds 23

Activity 1 24
Activity 2: Bird Observation 24
Activity 3: Feathers 31
Other Activities 31

Insects 33

Activity 1: Grasshopper Population Count 34
Activity 2: Collecting Cocoons 36
Other Activities 39

Mammals 41

Activity 1: Trapping Mammals Alive 42
Activity 2: Estimating Mammal Populations 48
Activity 3: Making Mammal Cages 50
Other Activities 54

Plants 57

Activity 1: Plant Ground Cover 58
Activity 2: Plant Distribution 59
Other Activities 60

Soil 65

Activity 1: A Colour Guide 66
Activity 2: Collecting Samples for Colour Comparisons 67
Activity 3: Comparing Soil Colours on Hillsides 69
Other Activities 70

Streams 73

Activity 1: Rate of Flow 74
Animal Factors 76
Plant Factors 77
Physical Factors 78
Interdependence 79

TO THE TEACHER

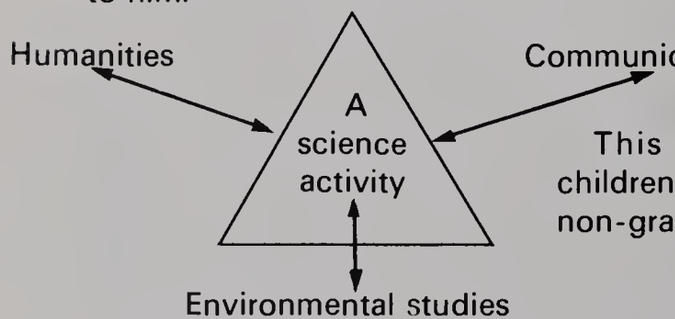
Studies for Open Places is an introduction to a series of books to be used individually by pupils in outdoor situations, as a beginning for inquiry into science. It contains units on Birds, Insects, Mammals, Plants, Soil, and Streams and a Companion book on each topic will provide additional activities and information, partly in the form of children's results to enable teachers and pupils to make comparisons.

In planning the series, several basic assumptions were made.

1. Excitement and stimulation come from inquiring about real things. The outdoors is an ideal laboratory.
2. An atmosphere where pupils can become involved to find self-satisfaction from their success is preferable to a content-oriented curriculum.
3. A greater employment of individualization is aimed at helping children to improve their creativity, while at the same time it enhances retention and transferability. In collecting data, children utilise such faculties as reasoning, perseverance, flexibility and improvisation. These, coupled with concrete experiences, increase the problem-solving ability of the learner.
4. Inquiry learning will be more rewarding if it receives some direction. An interpretation of some of the skills the series can help to develop over a period of time is given on page 9.

Activities begin with searching, observing and collecting. Individual recording to make findings intelligible to others will invariably lead to problems of organization and classification.

In recording, pupils will utilise skills developed in other subject areas, and temporary solutions lead to new and more exciting problems. Continued search fosters experiment, prediction and generalization. The drawing of inferences and interpretation of self-gathered data cause learning to become an integrative process where the pupil uses all sources to find an answer that is suitable to him.



This series is designed for children ages 8 to 14, and is non-graded in approach.

Some Skills to Consider

Teachers should consider development of skills. Here is one general approach.

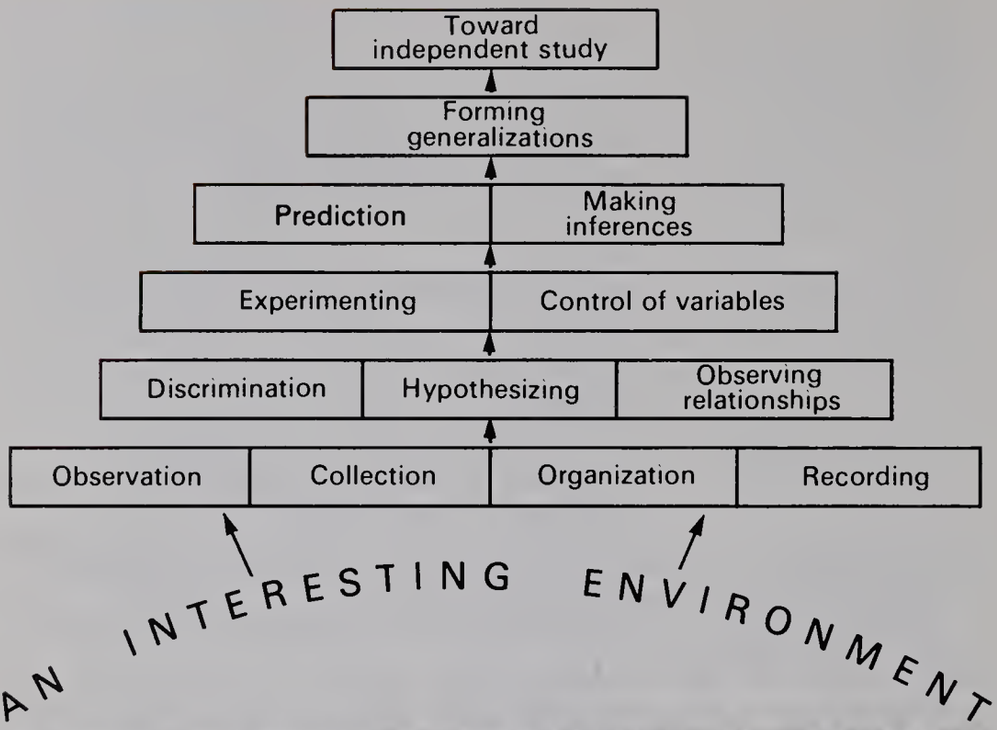
The skill	*What the child does when using the skill*
Observation	—uses the five senses to detect details, similarities and differences
Collection	—gathers information, materials etc. into one place
Organization	—sorts materials, data etc. into a meaningful scheme
Recording	—makes notes, constructs graphs, charts, diagrams
Discrimination	—selects irregularities in a situation
Hypothesizing	—suggests a theory to explain what is not completely understood
Observing relationships	—notes connection between one variable and another
Experimenting	—uses equipment to demonstrate or test an hypothesis
Control of variables	—purposefully handles the changeable aspects of an experiment
Prediction	—weighs data to indicate further events
Making inferences	—uses induction or deduction to present a possible solution
Forming generalizations	—reduces information to a general law or rule (the conclusion may be tentative)

Before children commence an area of investigation, it is useful for the teacher to state behavioural objectives. This type of planning would include:

an initial statement of intent;
a general description of the over-all behaviour in qualitative and quantitative terms;
a definition of important conditions; and
a criterion to measure performance.

It is suggested that the general skills shown above be used as beginnings for the development of behavioural objectives to meet specific needs. Meaningful planning can best be done by the people directly involved. For an excellent but short reference for setting educational objectives, see Robert F. Mager, *Preparing Instructional Objectives,* Fearon Publishers, Palo Alto, California, available in Canada from Clarke Irwin & Co. Ltd., Toronto.

A Relationship of Skills

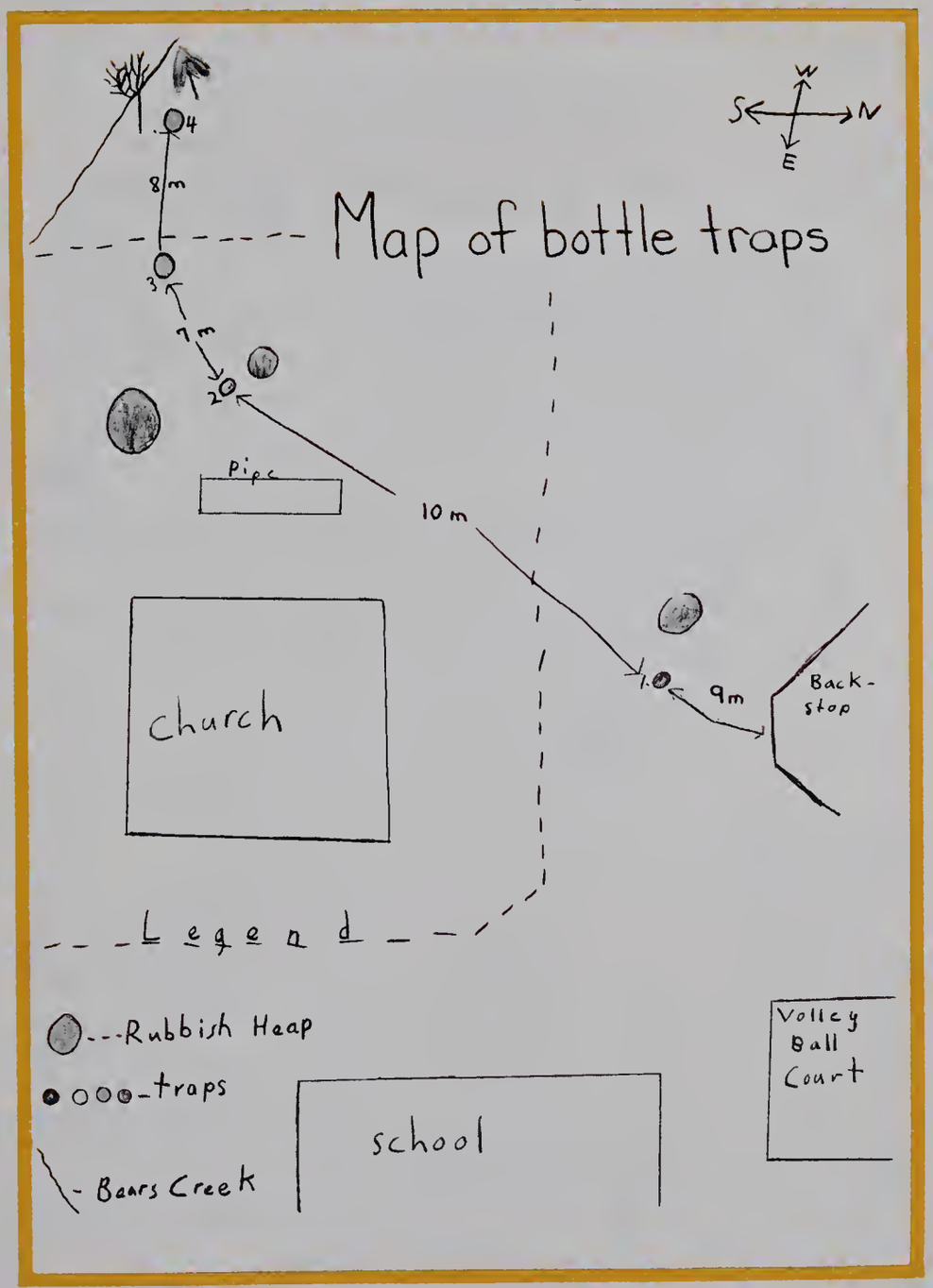


The Globe and Mail, Toronto

SUGGESTIONS FOR MAPPING

Making maps in science activities is not intended to be an exercise in art. A map should assist children in their scientific investigations, recording of information, locating a specifically studied area, and communicating data to others. Here are some children's maps.

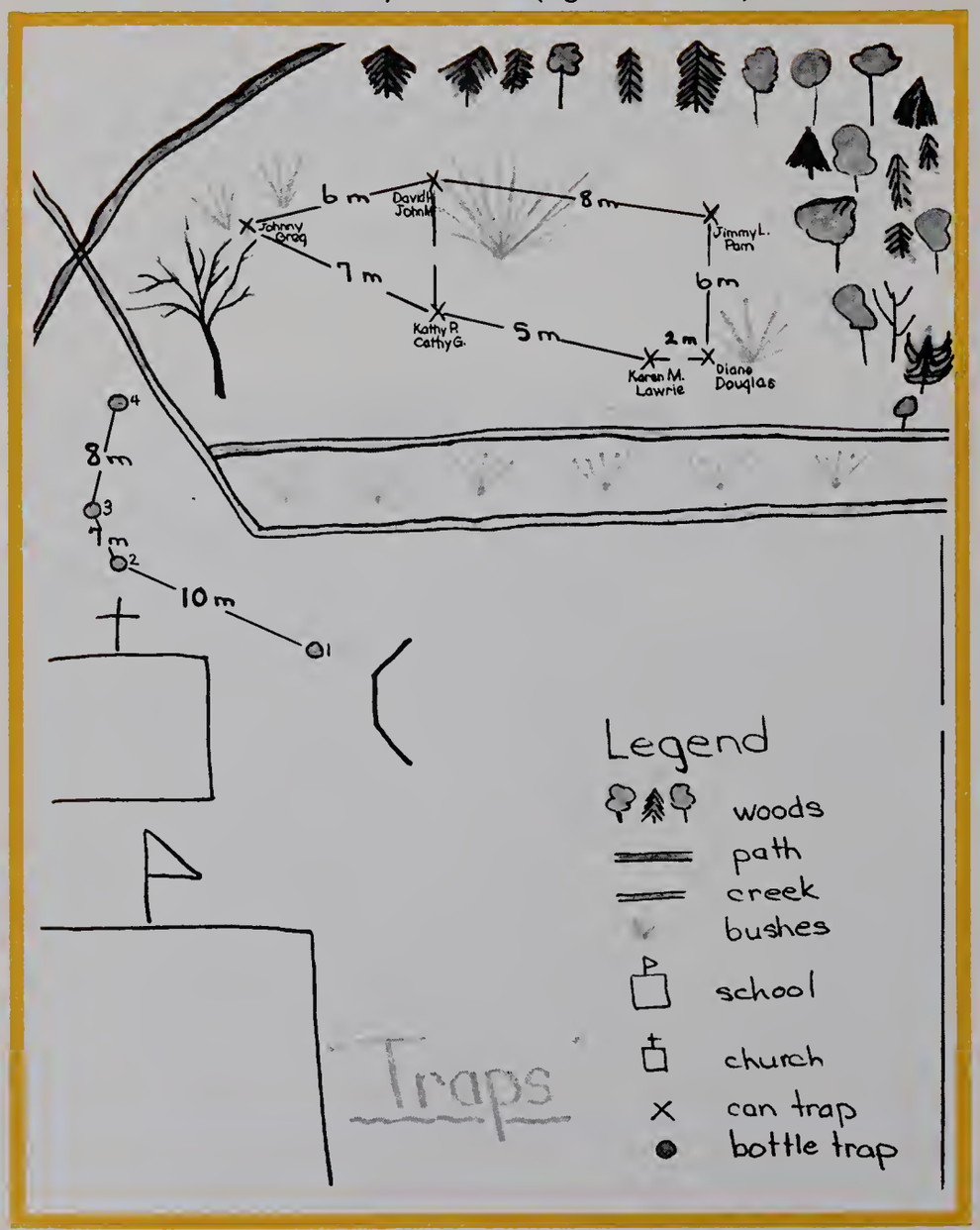
1. Karen Sanders (aged 8)

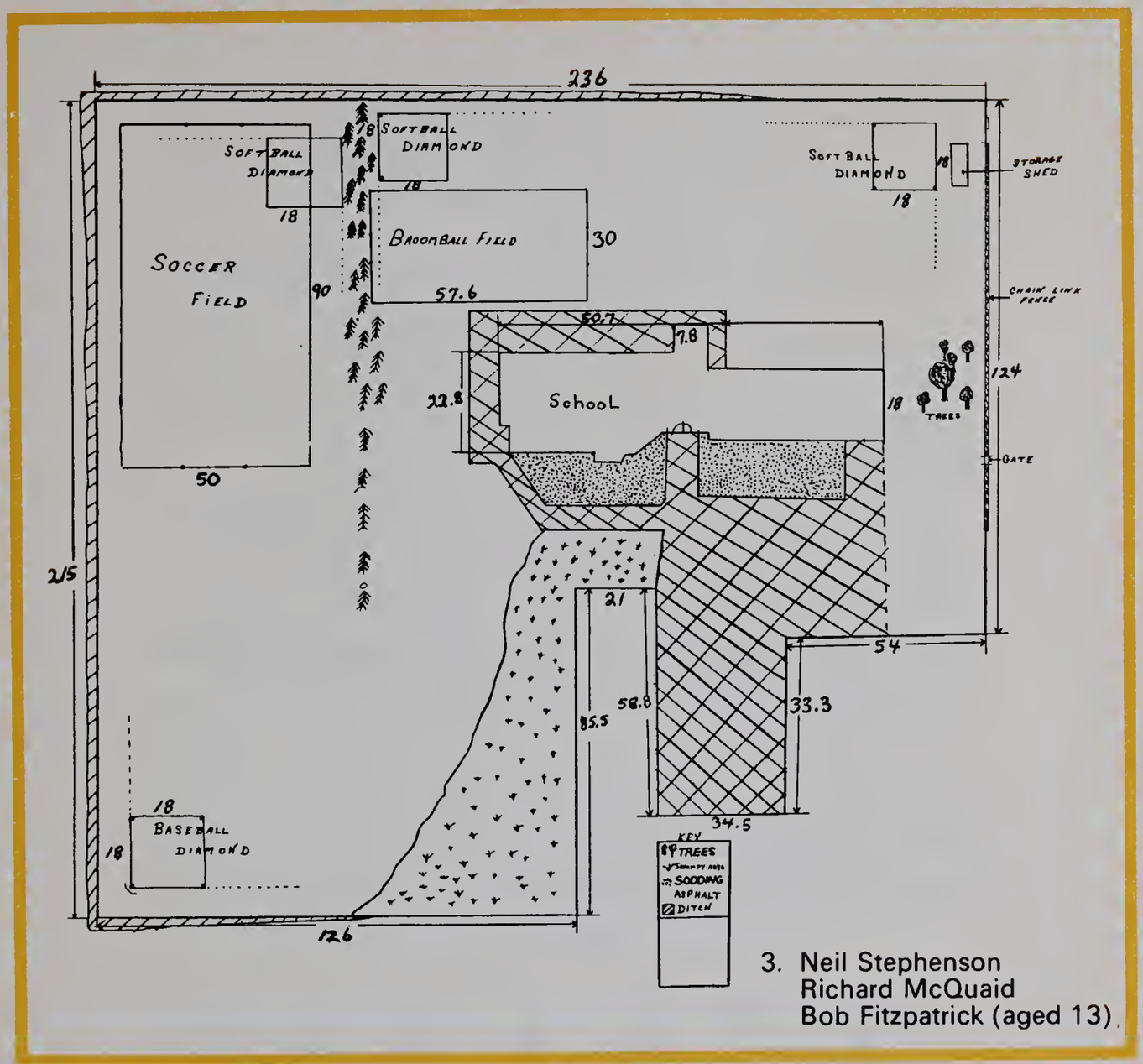


From the outset, map-making should be simple, clearly presented and practised so that students quickly realize the necessity of using standard symbols and terminology. Practice in mapping the classroom, playground, and then small segments of the community, before moving into an open area, will prove beneficial.

As children develop facility in map-making, the teacher should encourage the use of grid systems and standard map symbols.

2. Third year class (aged 8 and 9)





3. Neil Stephenson
Richard McQuaid
Bob Fitzpatrick (aged 13)

road

road overpass

road underpass

railway

buildings

church

mine

quarry

gravel pit

cliff

stream

stream, in wet weather only

cutting

embankment or dump

lighthouse

pier

swamp

HINTS FOR SAMPLING

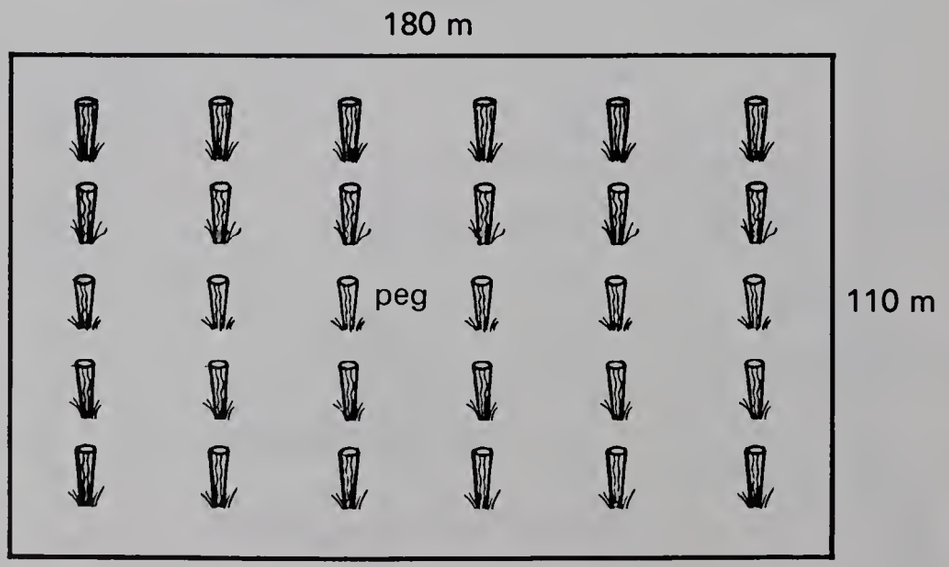
When you wish to study real things, you are often faced with the problem of coping with many objects spread over a large area. Since it is impossible, for instance, to gather data on all plants in a field, it is necessary to select. If a few plants are chosen for study, this is a sample.

Choosing samples is important. The first problem to be determined is that of what areas are available. If a variety of locations exist, it might be useful to study samples from a variety of places. This might reveal differences between woodlands and open areas, hills and valleys, dry land and damp areas, large areas and small plots, and so on.

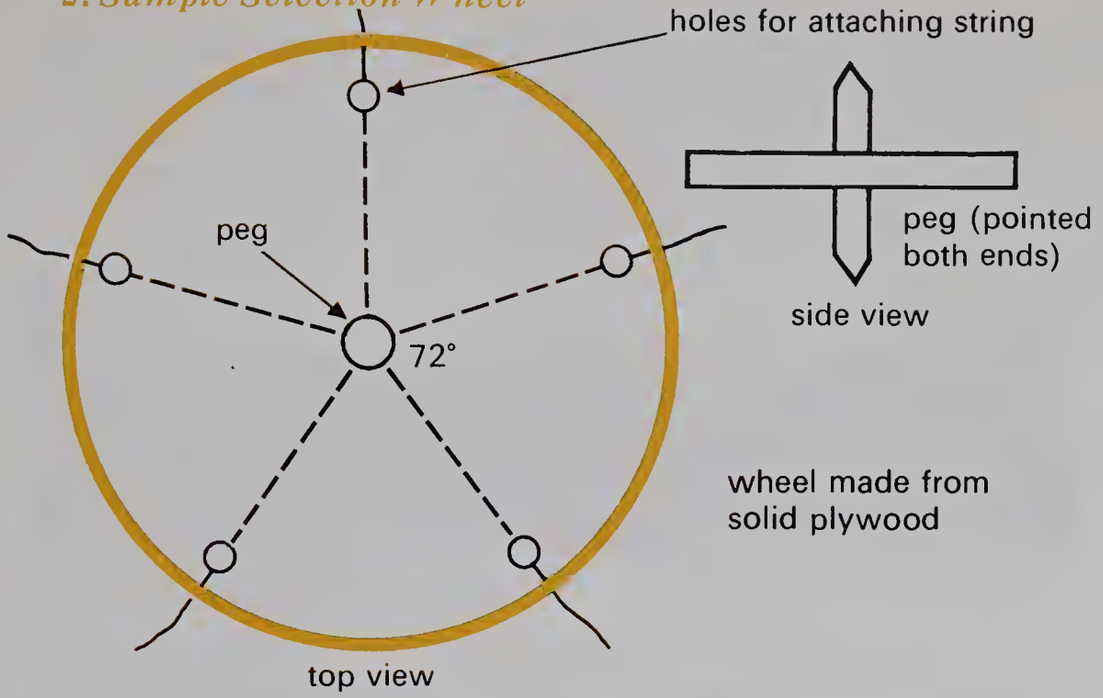
Once the area has been picked, there are many ways to make the selection of samples as random as possible. Random means that every object being collected has as good a chance of being selected as any other. If, for instance, you shook 10 marbles in a bag and took out one, each marble would have the same chance of being chosen.

1. Using Pegs

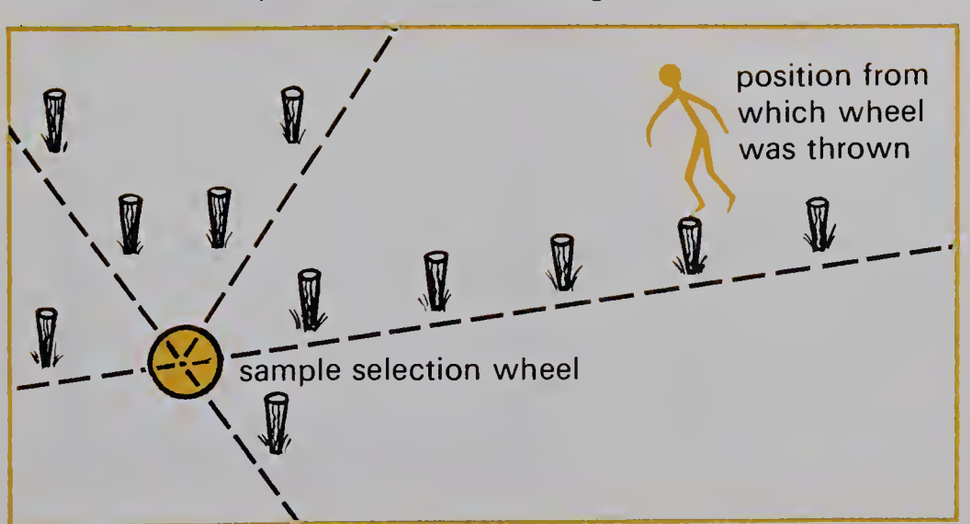
Pegs can be evenly spaced
to form a type of grid
as shown in the following diagram.



2. Sample Selection Wheel

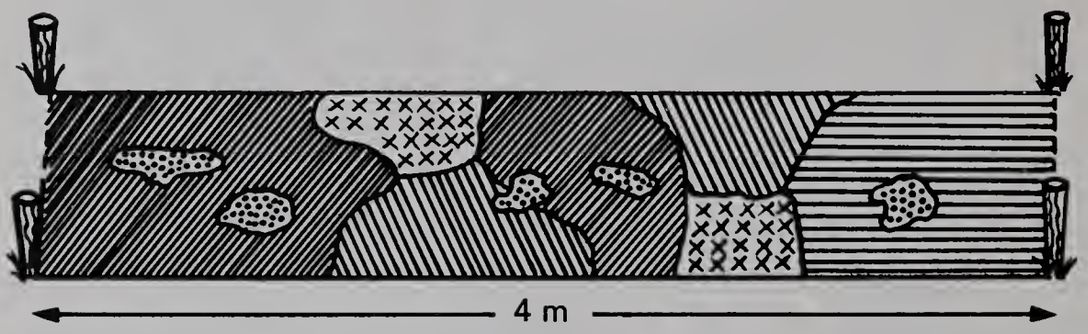


Throw the wheel in an open area so that it spins at the same time. When the wheel lands, the peg should be pushed into the ground without turning the wheel. An imaginary line might be extended along the dotted lines on the wheel to the edge of the site where the sample is being taken. If strings are available, they would be most useful tied through each hole and then extended beyond the wheel. The following diagram shows how samples were taken using this wheel.



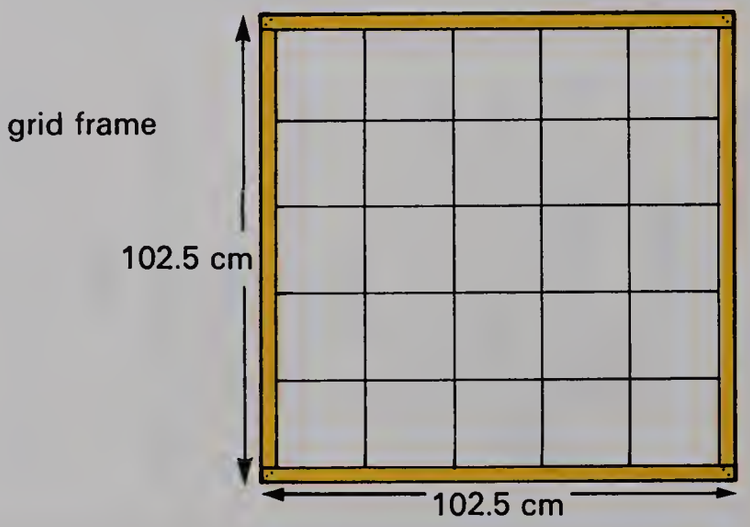
3. The Belt Transect

The belt transect is useful to sample in narrow strips. Peg out two parallel lines across the area to be used for the count (see diagram). Map the area you have pegged, section by section, on graph paper. Each type of shading represents a different ground cover or specimen.

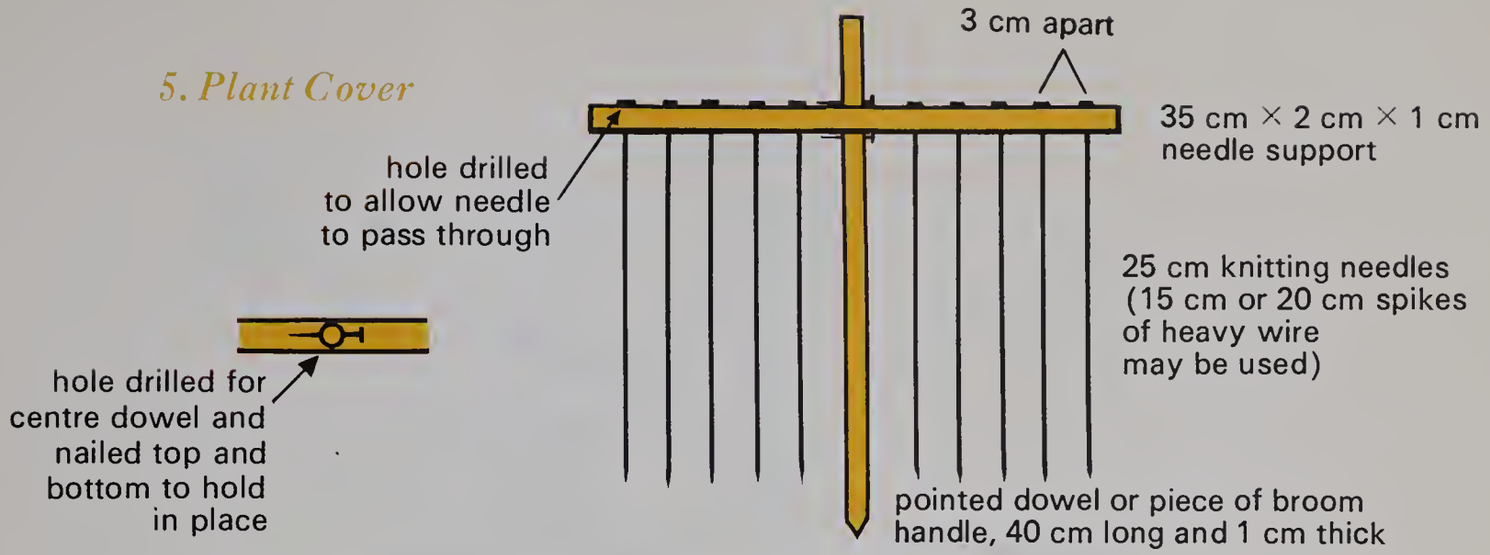


4. The Quadrat or Grid Frame

This sampling method is used for selecting field layer plants or other specimens found within a small area. Make a 1 m square frame from 2.5 cm lath and tie heavy strings at 2 dm intervals. Throw the frame and take a sample by counting the specimens within the frame. Record the results from each square. Repeat this method to get several samples before you attempt to find how often the types occur.



5. Plant Cover


3 cm apart
35 cm × 2 cm × 1 cm needle support
hole drilled to allow needle to pass through
25 cm knitting needles (15 cm or 20 cm spikes of heavy wire may be used)
hole drilled for centre dowel and nailed top and bottom to hold in place
pointed dowel or piece of broom handle, 40 cm long and 1 cm thick

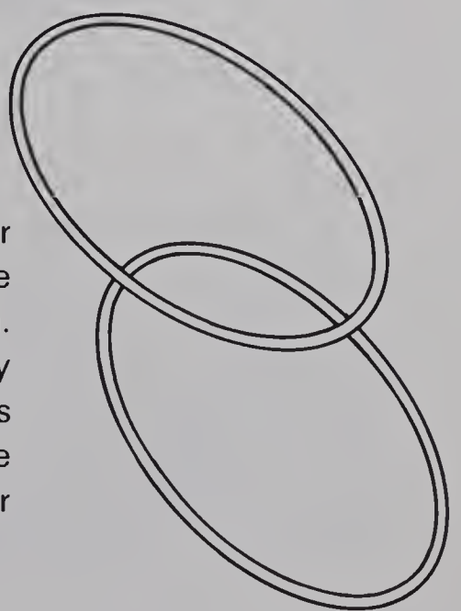
Make the instrument shown above and throw it in the open area. Where the point of the dowel lands, push it straight into the ground until the ends of the needles touch the plants. Identify and record each plant type that is touched. This could give you up to 10 plants for each trial. Repeat this method at least 20 times. Now add the total number of touches for each type of plant. Write this final answer as a fraction or percentage of the total number of plants touched to get an estimate of the amount of ground covered by the particular plant. This method could be used for other types of sampling, such as grain sizes of gravel. Example:

$$\frac{\text{plant type 1}}{\text{total touches}} = \%\text{ of ground covered by plant type 1}$$

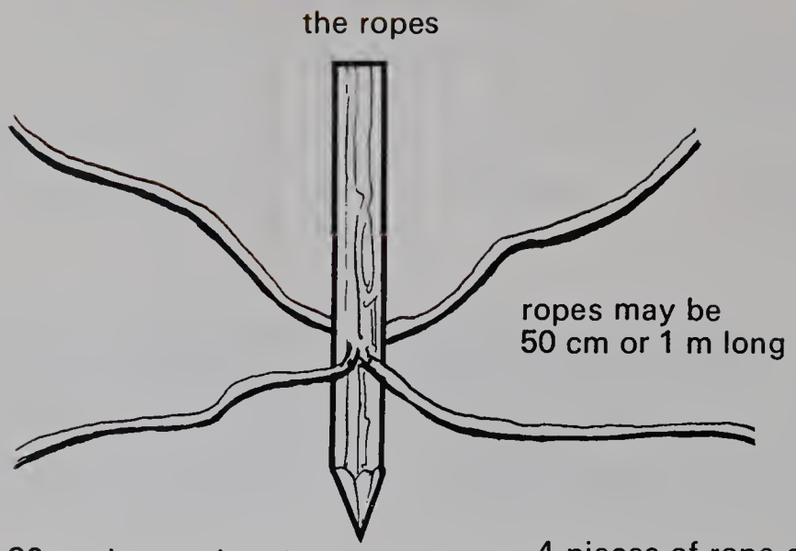
$$\frac{40}{160} = 25\%.$$

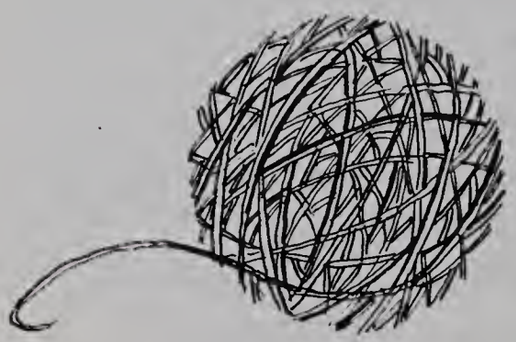
6. Throwing the Hoop

Throw a hula hoop over your shoulder in any direction. Count the specimens inside the hoop area. Estimate the amount of cover by any one type of plant. Take 20 samples before you work out the part of the open area covered by a particular specimen.



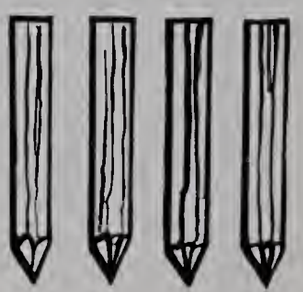
7. Throwing the Ropes


the ropes
ropes may be
50 cm or 1 m long
30 cm long pointed
piece of wood
4 pieces of rope or butcher
cord all the same length,
tied or nailed to the wood

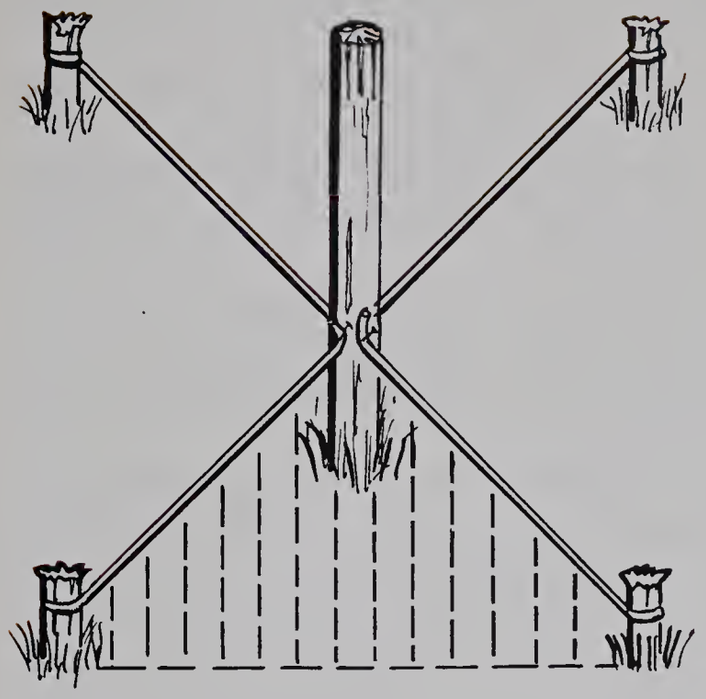


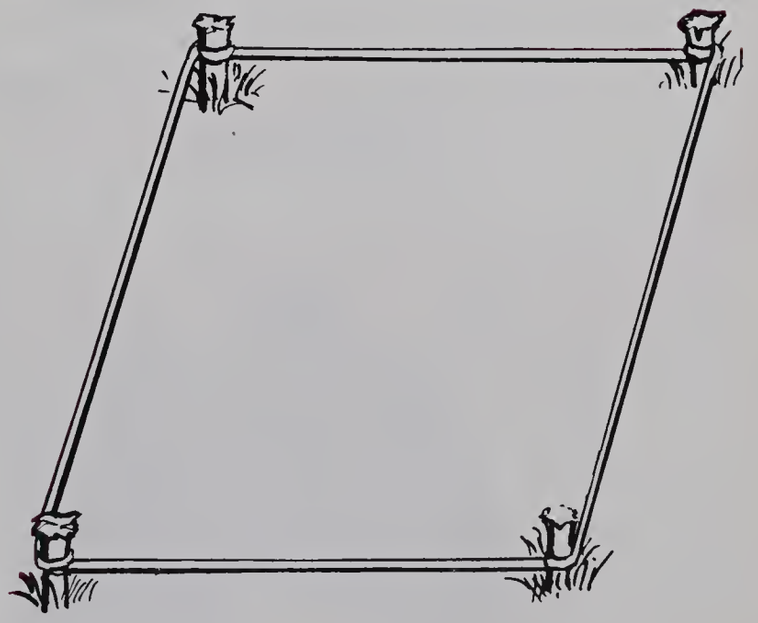
ball of string

4 stakes



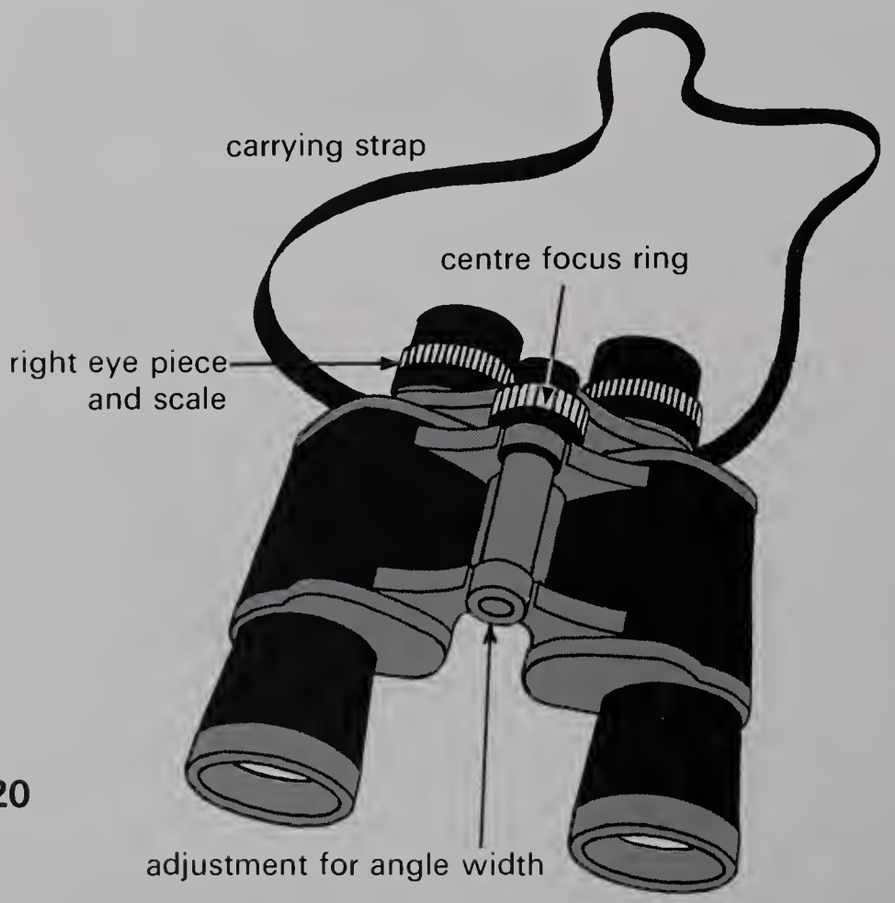
This is another useful method of studying ground cover. Construct the equipment as shown in the diagram. Throw the ropes in any direction in the open area. When they land spread them out as shown. Now mark the square by placing the pegs at the ends of the ropes. Tie the string around the end of the pegs to make your study plot. You may not wish to use the whole square as the sample. Try using one half of the plot or one of the triangular areas.





USE OF BINOCULARS

1. Always use both hands to hold your binoculars steady.
2. A distant object is most easily found in the binoculars if you watch the object and raise the binoculars directly to your eyes without looking away.
3. Knowing how to properly set binoculars is important.
   (a) Adjust the width of the binoculars to best suit your eye width.
   (b) Close the right eye. Focus object in distance by turning the centre focus ring.
   (c) Close the left eye. Focus same object by turning the right eye-piece.
   (d) Next, using both eyes, make final adjustment by focusing the centre ring.
   (e) Remember the setting on the scale of the right eye-piece. It will always remain the same, depending on your eyes. If it is changed at any time, it can automatically be reset without repeating the above procedure. An object will simply be brought into focus by adjusting the centre focus ring.



TO THE PUPIL

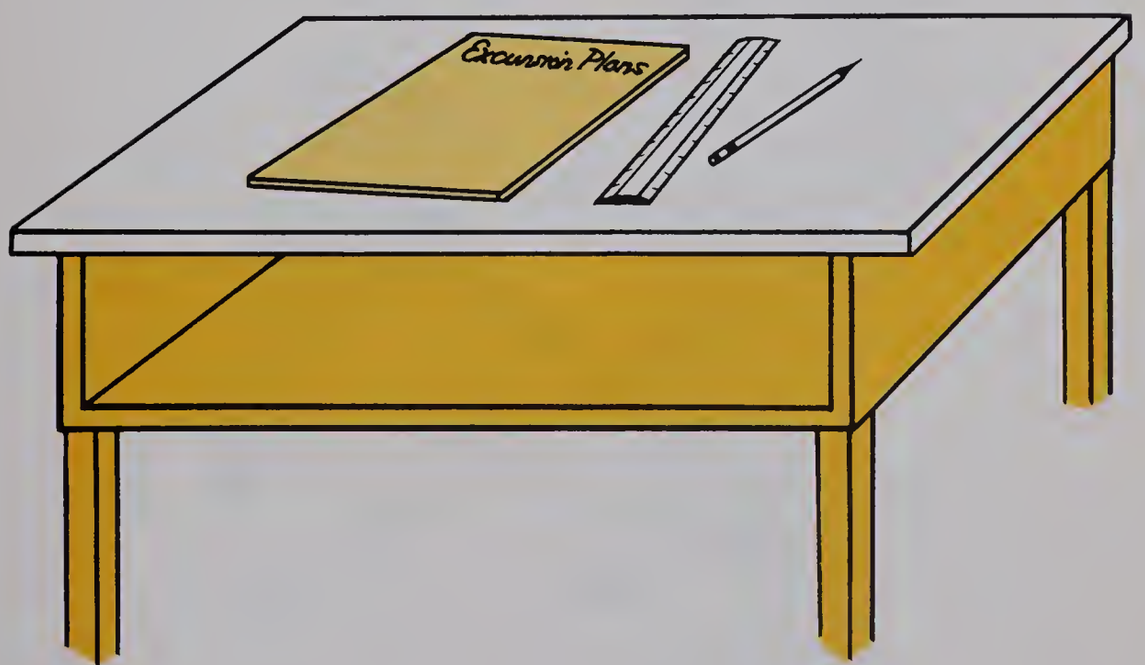
Your studies are likely to lead to a wide variety of findings. At the end, it would be useful to combine these to determine relationships that exist. For instance, how might the colour of soil be related to its composition, where it is found, temperature changes, grain size, water-holding capacity and origin? These are only a few of the questions that are likely to arise.

Always attempt to share your findings and problems. The companion books for each of the six units will give you additional activities, information, and results of other pupils' work.

Before going outdoors for any study it is necessary to ask a number of questions.

1. What materials will be needed?
2. Will we be working in groups?
3. How will our records be kept?
4. What do we hope to achieve with these studies?

It would be useful to take this book along with you on field trips.



BIRDS

INTRODUCTION

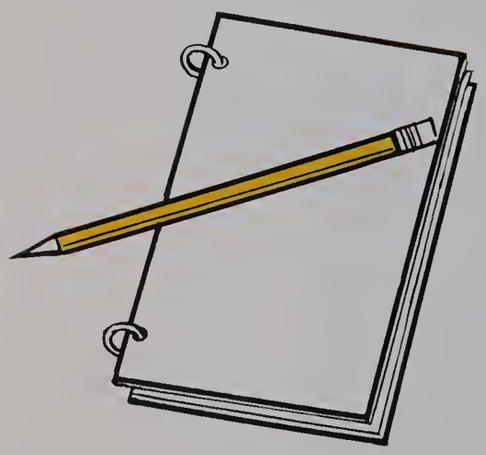
Record what you mean by the word bird. Compare your definition with those of the other pupils. In what ways are all birds alike? List these. Are there ways in which birds are not alike? Does your description apply to baby birds, dead birds and penguins?

Activity 1

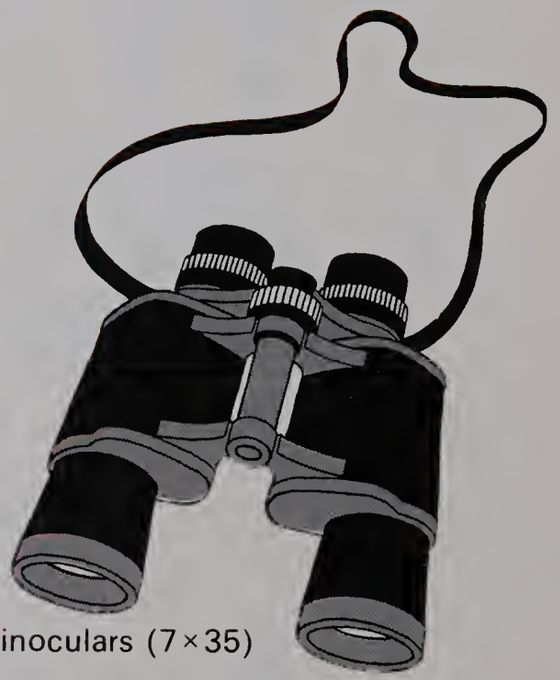
Go to an open area to observe birds. Develop a method by which you can tell them apart.

Activity 2: BIRD OBSERVATION

MATERIALS



record book and pencil



binoculars (7×35)

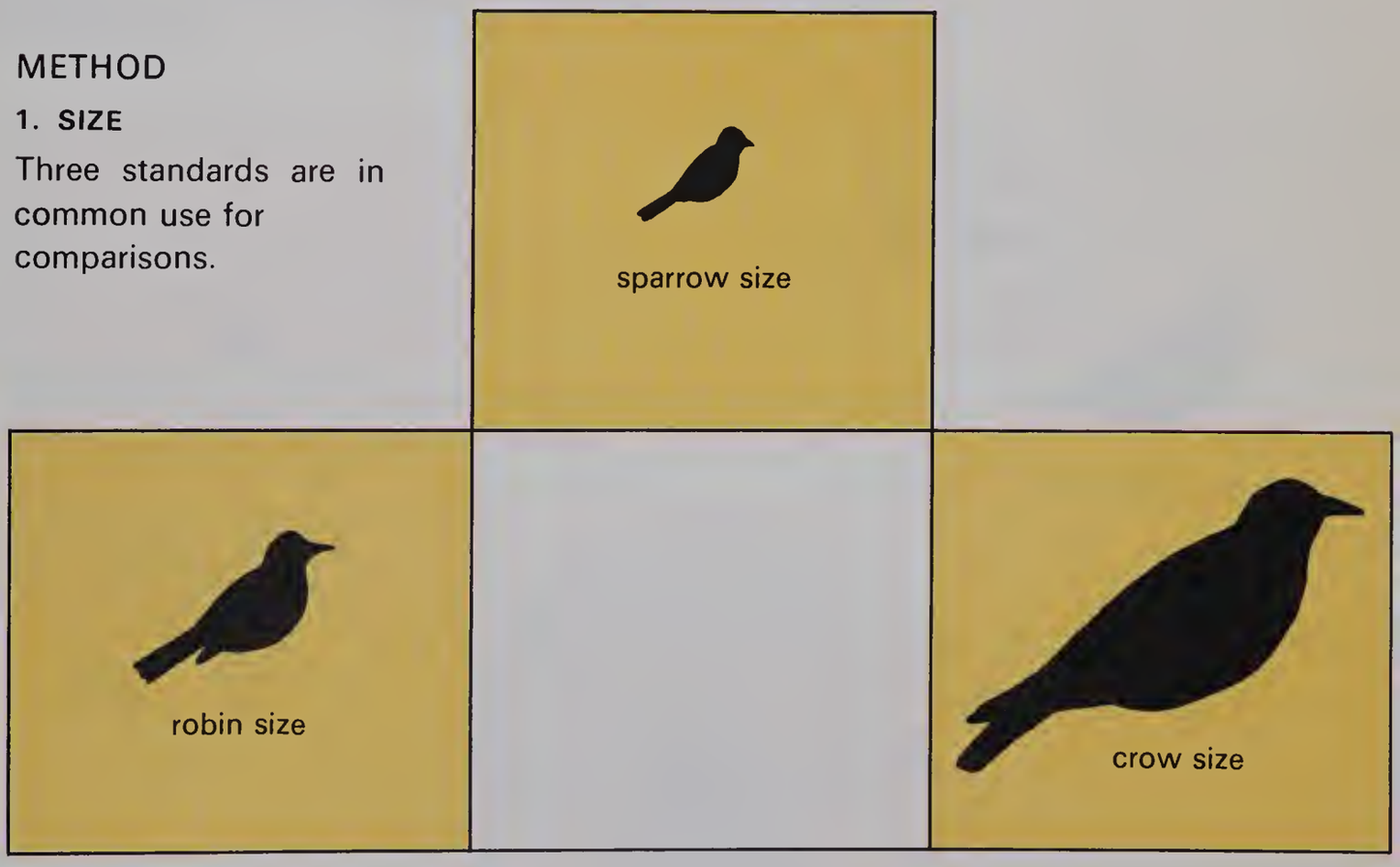
The "S" system is an aid to bird observation. The following activity is to be used in the field, and the method should be learned before going outdoors.

The above six points need explaining. Study the points, learn what to look for in bird observation and then make a chart similar to the one on page 31.

METHOD

1. SIZE

Three standards are in common use for comparisons.



Compare the size of the bird with that of a sparrow, robin or crow. Some birds may be smaller than a sparrow or larger than a crow. Take special notice of the length of tail, legs, wings and bill for a clue to the correct family.

2. SHAPE

Four shapes are in common use for comparisons.

chunky as a meadowlark

plump as a grouse

slender as a swallow

downright bulky as an owl

The use of cutouts or overhead transparencies assists in learning shapes. Compare the birds seen with one of the above standards. Note the shape of the bills in Figure 1.

Which is the most suitable for:

(a) probing in wet sand?
(b) cracking seeds?
(c) spearing fish?

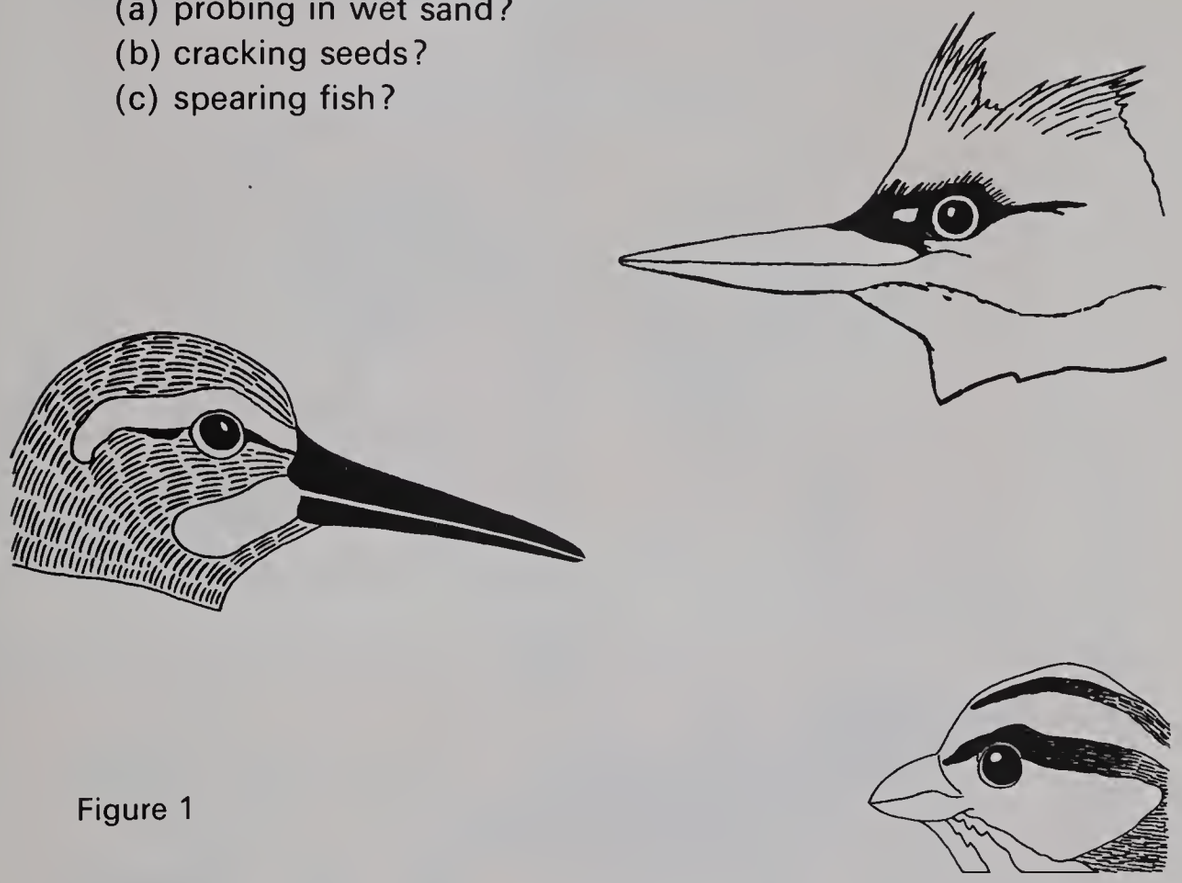
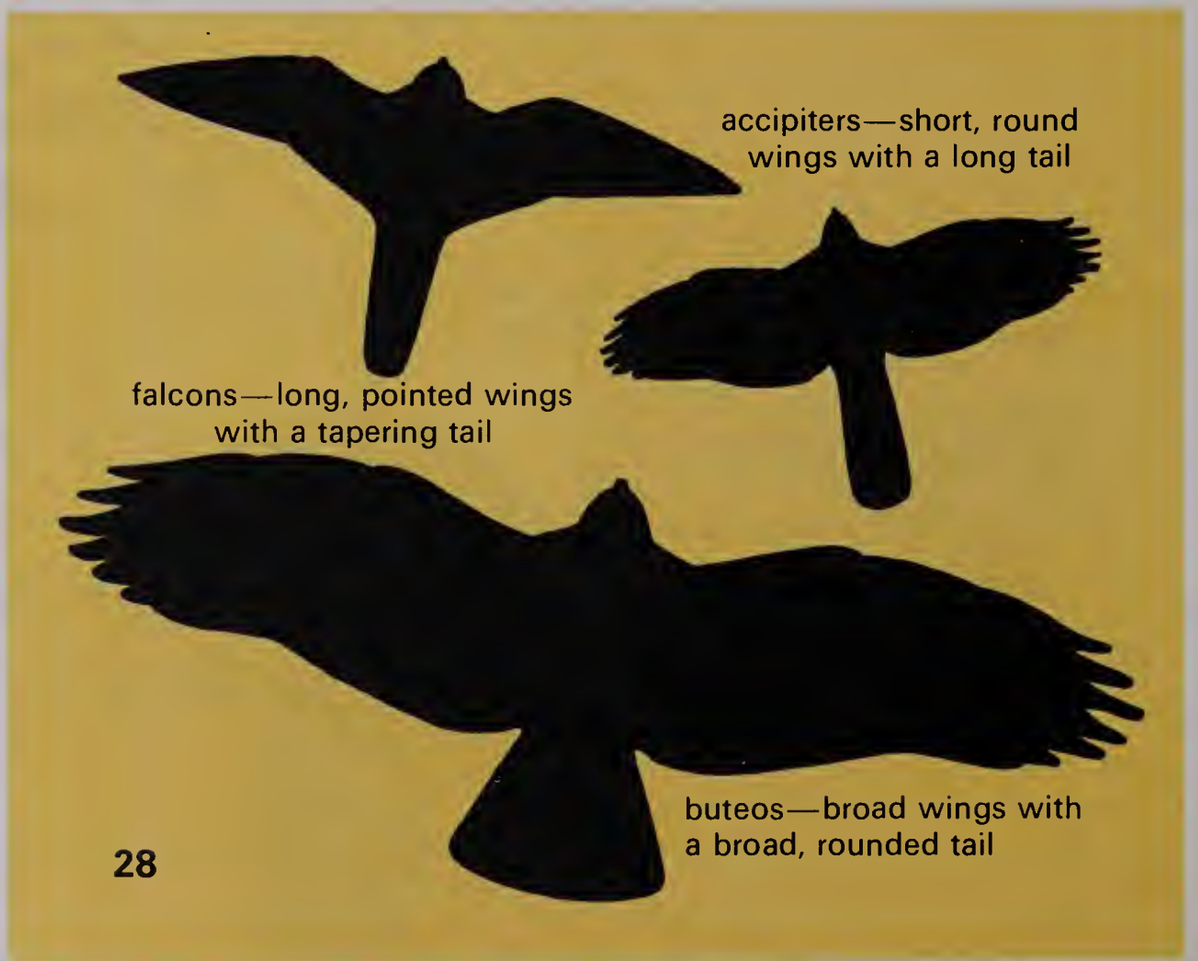


Figure 1

The shape of the head is important in identifying family groupings, particularly owls and ducks.

Tail and wing shapes are also useful in telling apart various species within family groupings, swallows for instance.

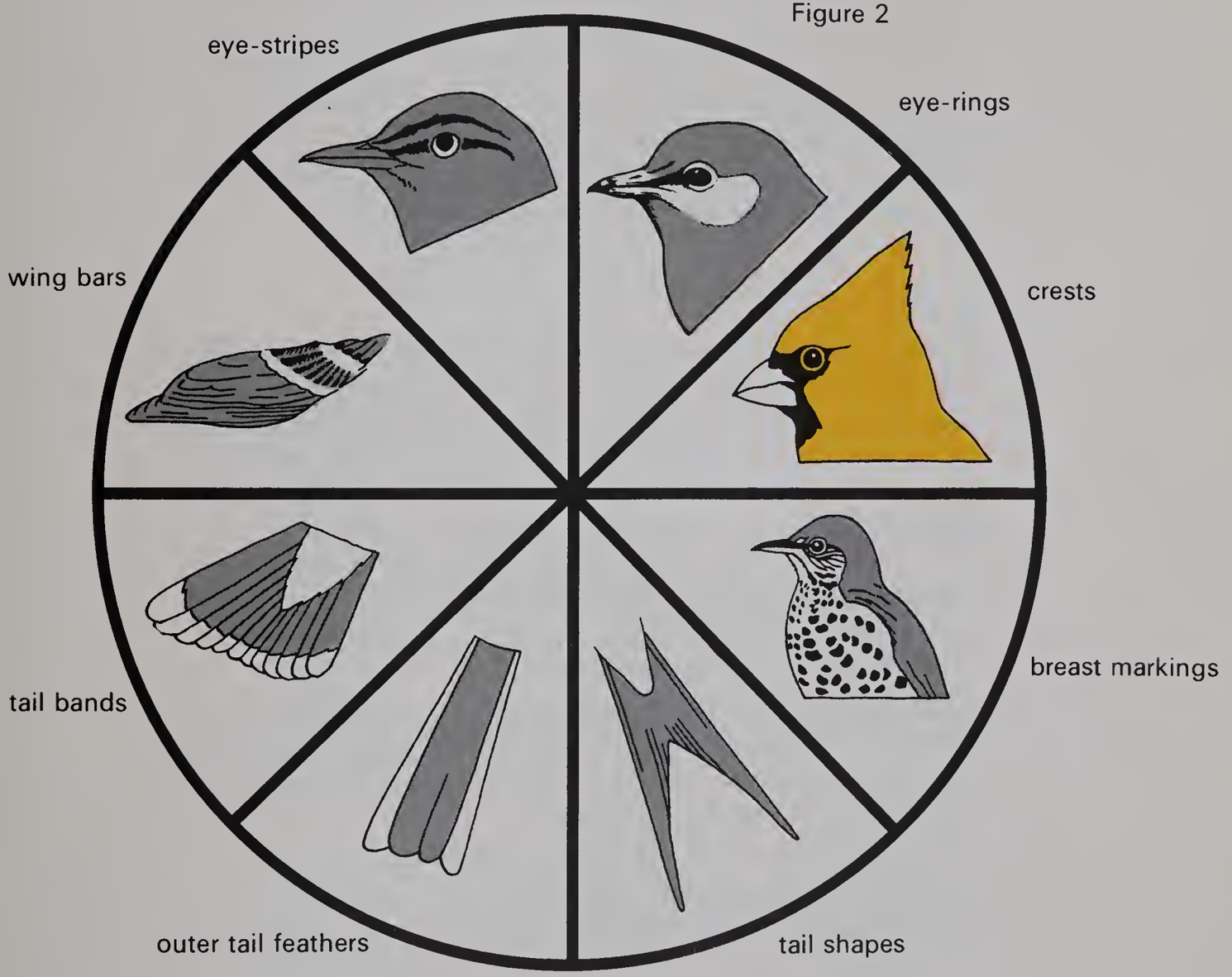
Wing and tail shapes and lengths help to distinguish three basic types of hawks.



3. SIGHT

This includes everything observed by the eye. What is the main colour of the bird? Is the bird mainly brown, red or yellow? What special markings does it have? Look for characteristic markings such as these in Figure 2.

Figure 2



Try to spot special habits of the bird such as an odd manner of flight, wagging the tail or teetering in a back and forward motion.

4. SOUND

This means every noise that the bird makes. Many birds call their own names. List five of these. Listen carefully and put to words the bird's song. Listen for and describe call notes and alarm notes. Records of bird sounds are available. Many birds make a characteristic sound. What noise does a woodpecker make with its beak? What sounds do swallows make as they fly overhead? Describe the call made by a startled kingfisher. Similarly, grouse make a drumming noise and many hawks scream. See the Companion Book, Bird Studies, for interesting experiments using a portable tape recorder to investigate a bird's breeding territory.

5. SITE

Sketch or record briefly the exact location of birds seen. During the breeding season (February to September) each species has a definite preference for a particular habitat.

6. SEASON

The season or date that a bird is seen is important. This may be shown by three main categories.

(a) Resident—year round.
(b) Breeder—summer resident.
(c) Migrant—spring and fall.

Develop a chart showing the above information, to aid in observing birds. The chart developed in the field might look like the one on the opposite page.

Using your chart, discuss these points.

1. Where would you expect each bird you observed to nest?
2. What food would they eat?
3. How were their beaks particularly suited to this type of food?
4. By using field guides, try to name the birds you saw.

SIZE	SHAPE	SIGHT	SOUND	SITE	SEASON
robin sized	-chunky	- brown/ yellow breast, black "V" - white ends on tail	- two clear whistles	- short grassy section	May 17 1970
- sparrow sized	-chunky	- brown - long tail - streaked breast - large central breast spot	- musical - 3 starting notes	- low shrubs and long grass	- May 17 1970

Activity 3: FEATHERS

From Activity 1 we have established that birds are covered with feathers.

1. Collect as many different feathers as possible. Group these to find their various uses.
2. Test feathers to find which are the most waterproof.
3. Examine a cut-off quill of a feather and write a description.
4. Sketch a feather as observed under a magnifying glass or microscope.

Other Activities

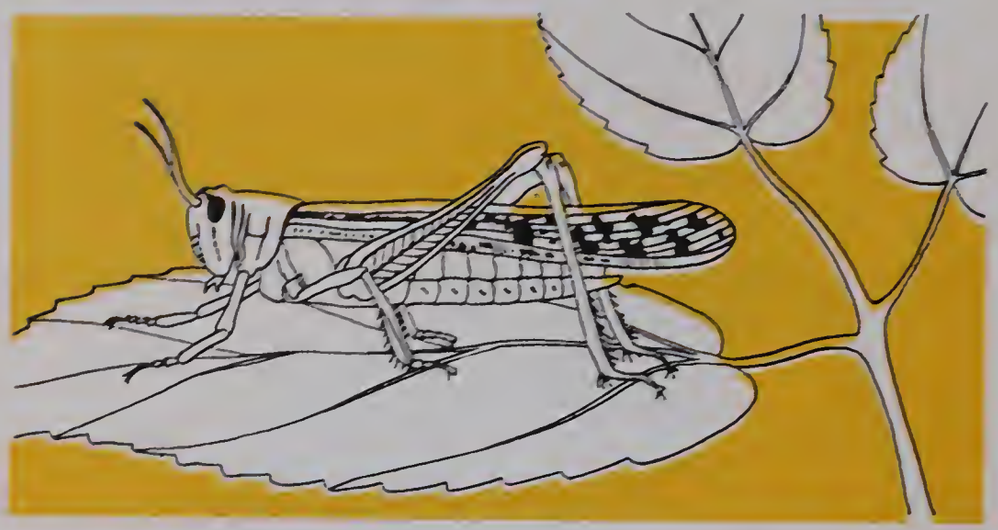
1. Sketching will help observation. You could use the "S" system key, or ovals and circles, or outlines. See the Companion book, Bird Studies, for assistance. Electric game boards are also useful.
2. Migration. Four major flyways exist across North America. Which is the route for your area? Find out by keeping various charts and graphs as suggested in the Companion book, Bird Studies.

3. Feeding Habits. Perching birds, shore birds and birds of prey eat different foods. Why? How are their beaks adapted to their particular foods? Why are their legs and feet so different? Explain from a bird's appearance what kind of food it will require.
4. Pellets. Search your area for a hawk's or owl's roosting site. Collect the pellets you find at this location. Dissect these and classify the contents.
5. Bird Feeders. Set out various types of food. Why are different birds attracted? The Companion book, Bird Studies, contains ideas on feeder construction.
6. Dissection. Obtain a chicken from the local market. Dissect it to learn about a bird's digestive system. Study the bone structure.
7. Nesting. Keep daily records at an active nesting site. Do not approach closely. How long does it take a bird to construct a nest? List the materials used. Where might each material have been found by the bird? Where do the various types of birds nest? When do birds nest? Occupied nests must not be disturbed.
8. Shelters. Build shelters or nesting boxes suitable for birds in the open area. The Companion book, Bird Studies, has some suggestions. Keep follow-up records.
9. Bird songs and calls. From a bird recording, tape the songs of several common birds of the local area. Take these to the open area. When these are played what reaction do you notice from the birds in the territory? Why?
10. Tracks. Many birds in an open area spend some time on the ground. How may these tracks be recorded?
11. Bird Photography.
12. Adaptations for flight.

INSECTS

INTRODUCTION

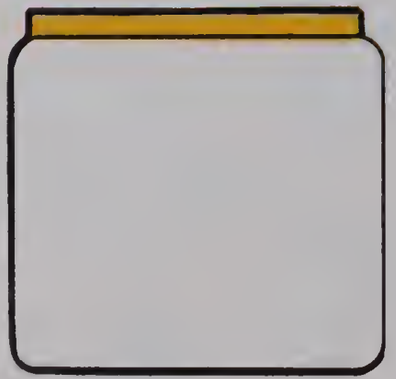
What is an insect? Write a description. Try to add to this by studying the following drawing.



This is a grasshopper, which is found in open places. Estimate the number in the open area you have selected for study.

Activity 1:
GRASSHOPPER POPULATION COUNT

MATERIALS

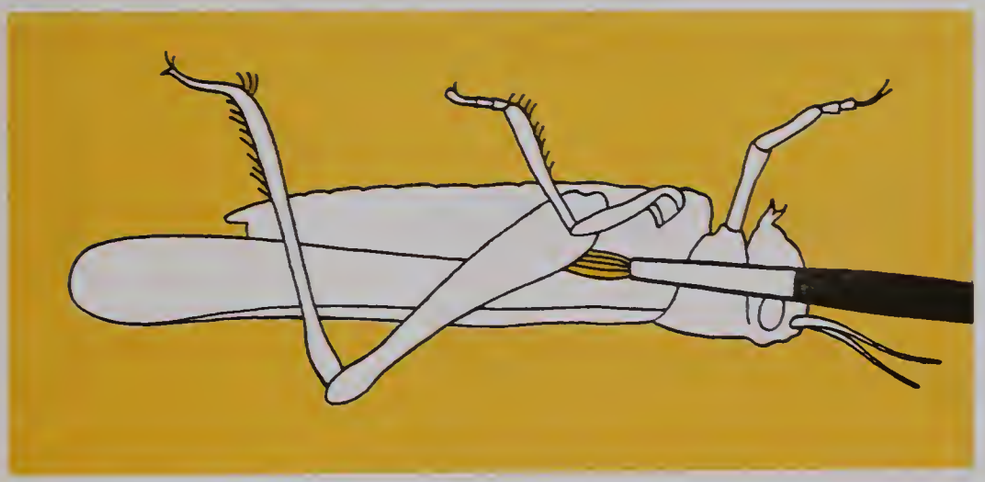


wide-mouthed bottle

small bottle of nail polish or plastic paint (any colour will do)

METHOD

1. Select an area about the size of an average school playground. All members of the group should join in catching a total of 50 insects. Record the number. Take care not to injure the insects.
2. All grasshoppers caught on the first day should be marked with a dab of nail polish or paint on the inside of a back leg so that it is not visible when the insect is in a resting position. Hold grasshopper upside down when dabbing paint.



3. Release the insect, unharmed, at the place where it was caught and marked.
4. On the next day, collect 50 insects from the same area. Count them and place them in a large jar. Record:
   (a) the total number in the jar.
   (b) the number marked with nail polish.
5. Apply the following formula to estimate the insect population.

$$P = \frac{C_1 \times C_2}{R}$$

P = Population
C_1 = Number of grasshoppers caught and marked on first day
C_2 = Number caught on second day
R = Number re-caught marked with paint

Here are the results of one class.

Grasshoppers caught and marked

on Tues. 15 Sept. 1970 = 50 (C_1)

Total caught Wed 16 Sept. 1970 = 50 (C_2)

Total recaptured (marked) = 4 (R)

Formula: $P = \frac{C_1 \times C_2}{R} = \frac{50 \times 50}{4}$ = 625.

There are about 625 grasshoppers

in the area. Lisbeth Boilesen

What could you do if you cannot find 50 grasshoppers?

Activity 2: COLLECTING COCOONS

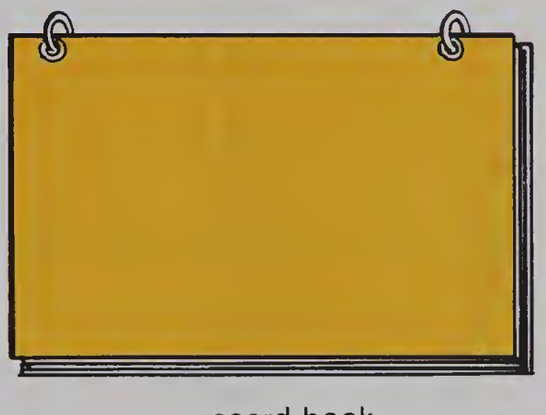
What is a cocoon? Write a description.

MATERIALS

pencil

small penknife

cigar box

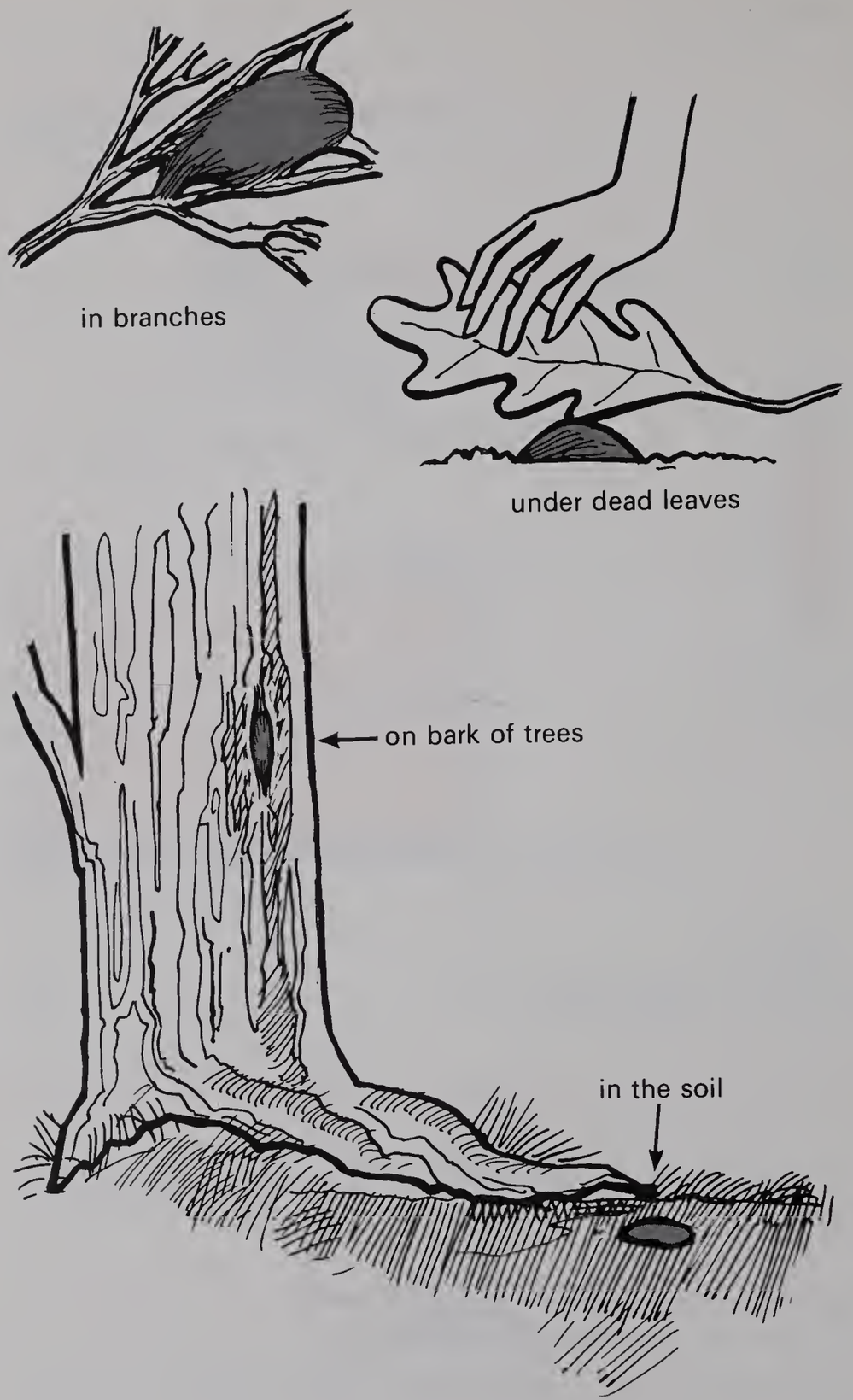


record book

METHOD

Where can you find cocoons?

under rocks


in branches
under dead leaves
on bark of trees
in the soil

1. When you find a cocoon, remove it carefully using a penknife.
2. Place the cocoon carefully in your box.
3. Make a label for each cocoon collected and include the following.
   (a) Exact location of find.
   (b) Date of collection.
   (c) Name of collector.
   (d) Name of specimen when identified.

When you return to the classroom, place the cocoons in a cage to discover what type of animal will come out of them. Check the Companion book, Insect Studies, to find out how to force cocoons. What is the difference between a cocoon and a chrysalis?

Other Activities

The Companion book, Insect Studies, will give you some ideas.

1. Make a home for insects in the classroom. This should be as similar as possible to their natural home.
2. Construct insect nets.
3. Study insect migration and banding.
4. Construct trapping devices for collecting insects.
5. Mount dead specimens.
6. How can you observe the life cycles of insects in the field and in the classroom? Do the cycles of insects change when they are brought indoors?
7. What is the relationship between plants and insects?
8. Harmful insects can be controlled. Which way is best?
9. Insect photography and art work are fun.
10. Compare a colony of social insects to man.

A BUG

I saw a bug
with twenty feet

Go crawling up
and down the street,

And wondered if
he stubbed ONE toe

If he would ever
really know.

Aileen Fisher

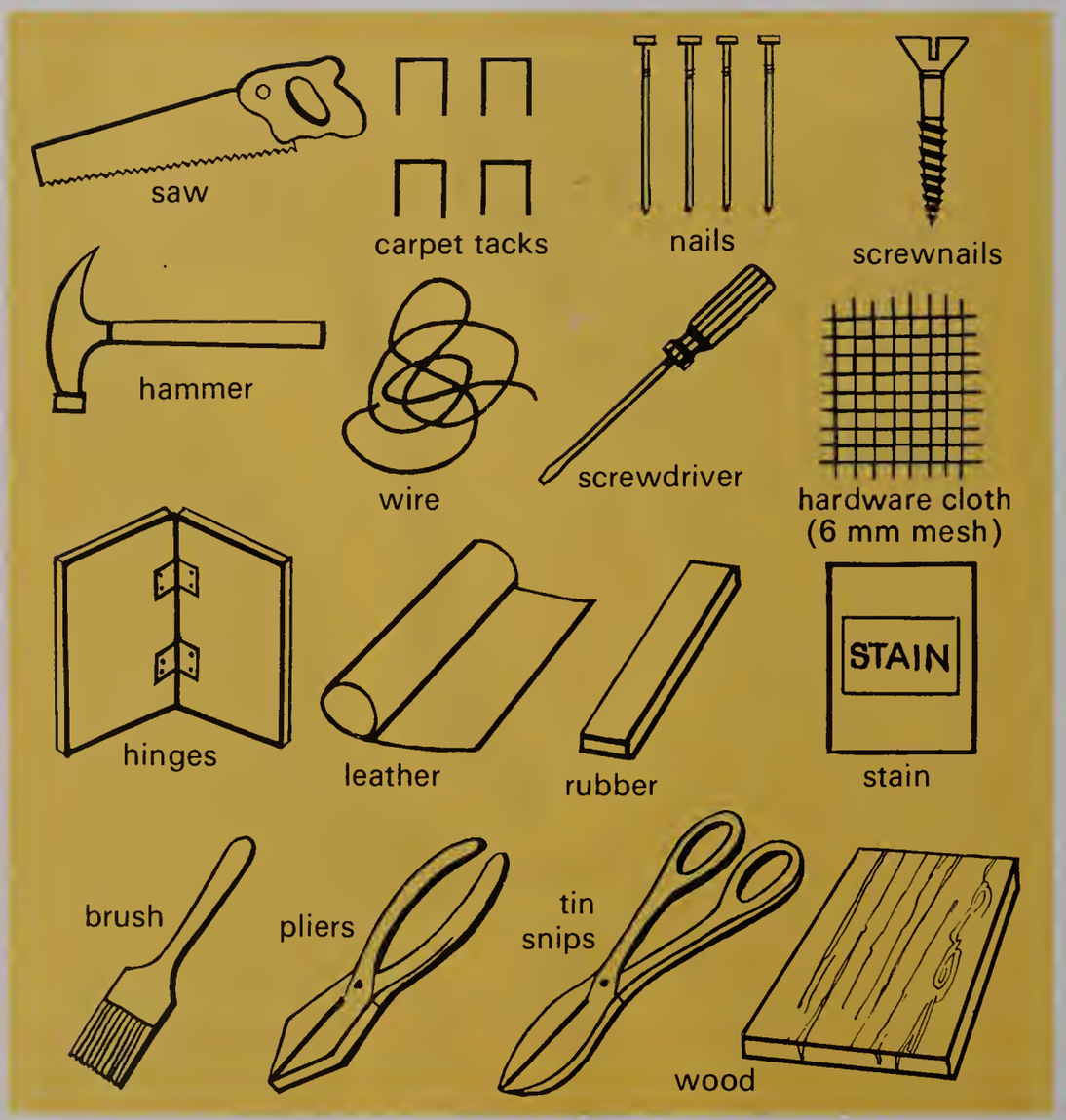
MAMMALS

INTRODUCTION

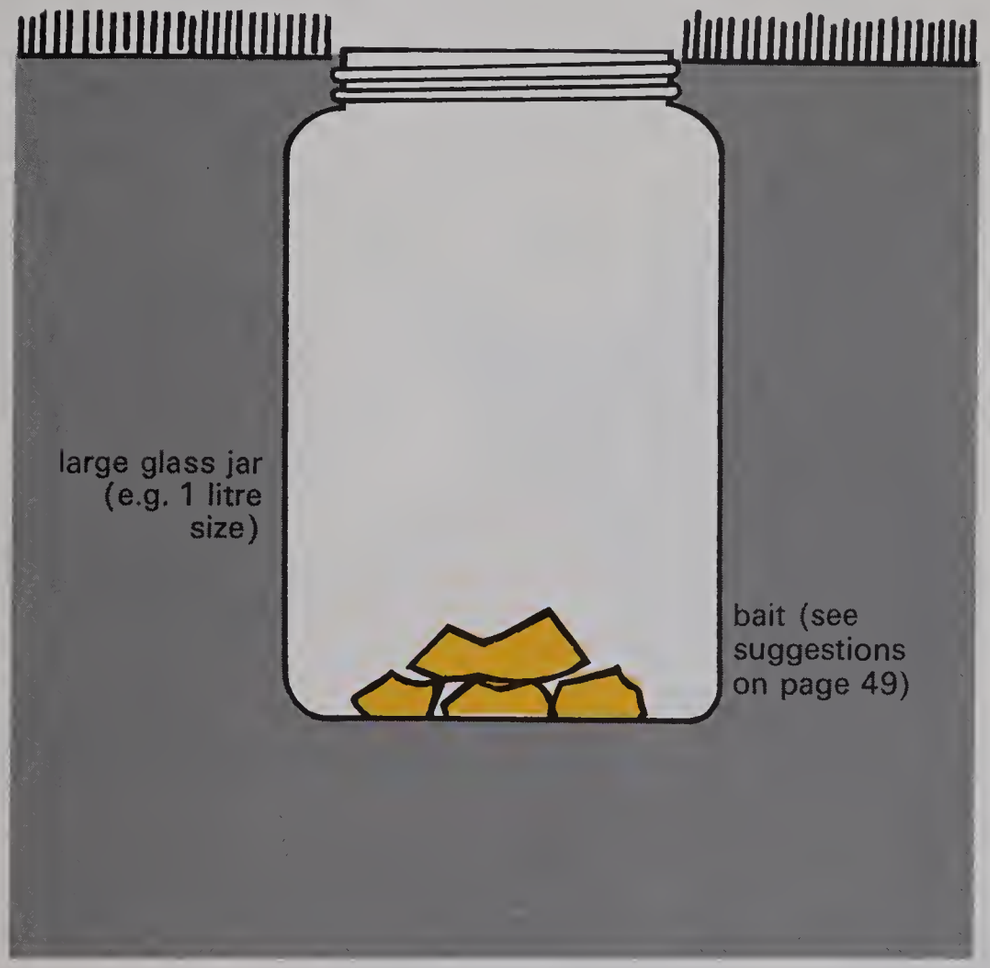
Study the diagram on the previous page and list some of the characteristics that are common to mammals. Discuss these. Name as many animals as you can that have some or all of these characteristics. Trap mammals for study.

Activity 1:
TRAPPING MAMMALS ALIVE

MATERIALS



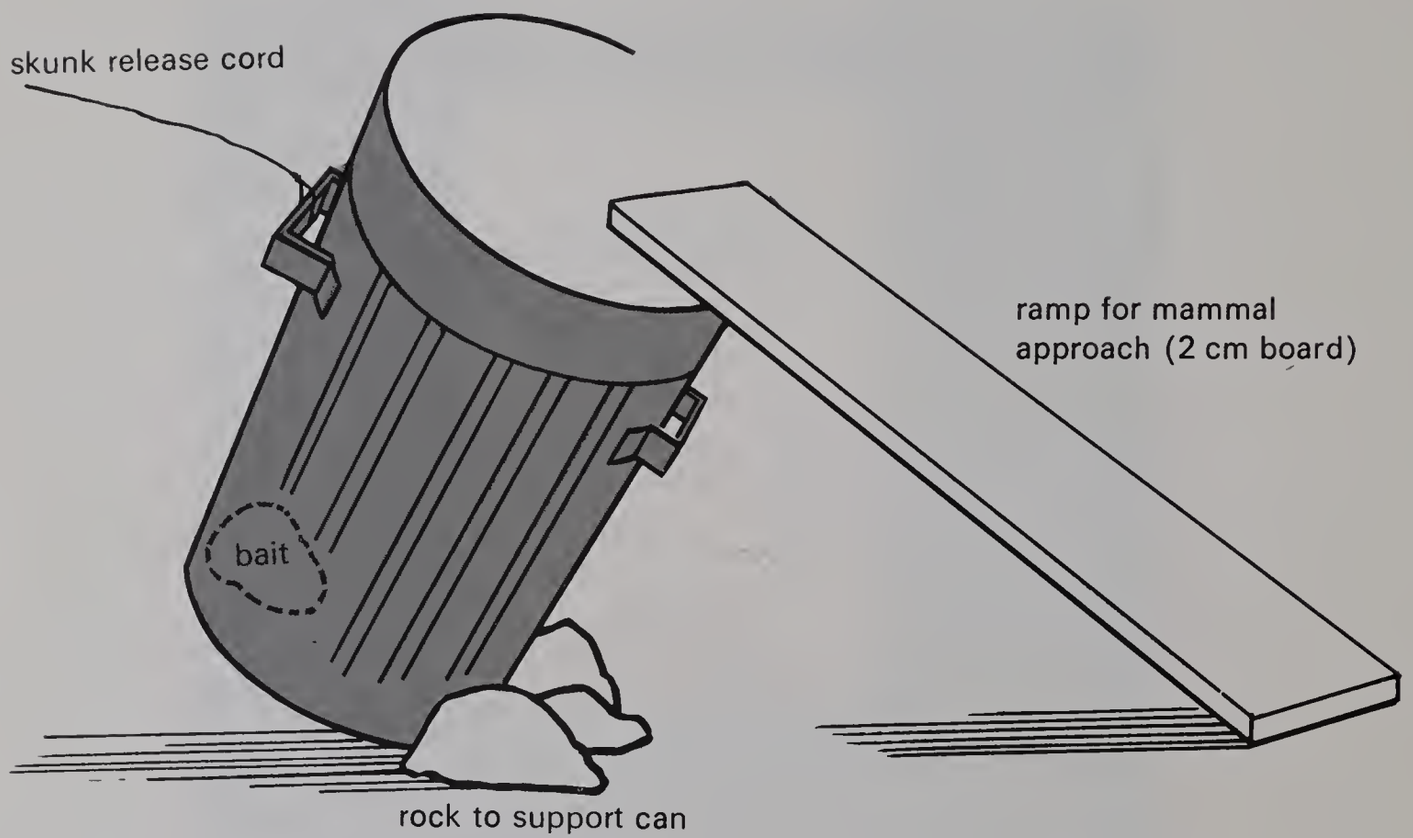
1. Glass bottle trap (for small mammals—mice, voles, shrews, moles).



This trap is set by burying the jar until the top is even with the ground level. Fill the earth in around the sides and leave the surface to look as if it had not been disturbed. If bottles are not available, use large tin cans (at least 1350 grams).

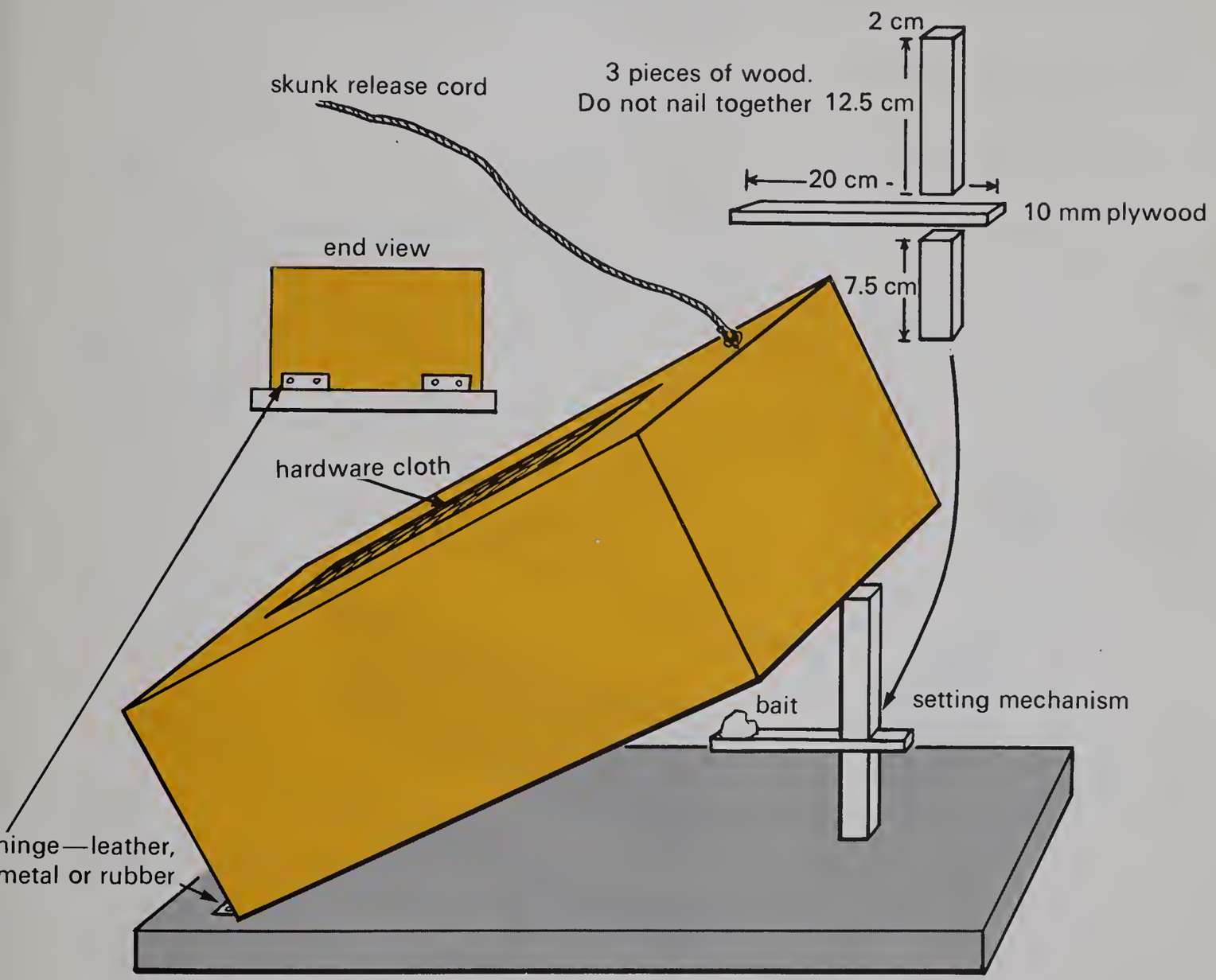
IMPORTANT: Shrews can die very quickly from starvation or cold. Check the trap every two hours. Close at night.

2. Garbage can trap (for larger mammals, such as a raccoon).



The inside of the garbage can should be greased or coated with vaseline to provide a slippery surface so that the mammal cannot climb out. The trap should be set so that the can will fall into a vertical position when the animal jumps to the bottom. At the same time the board ramp should fall away.

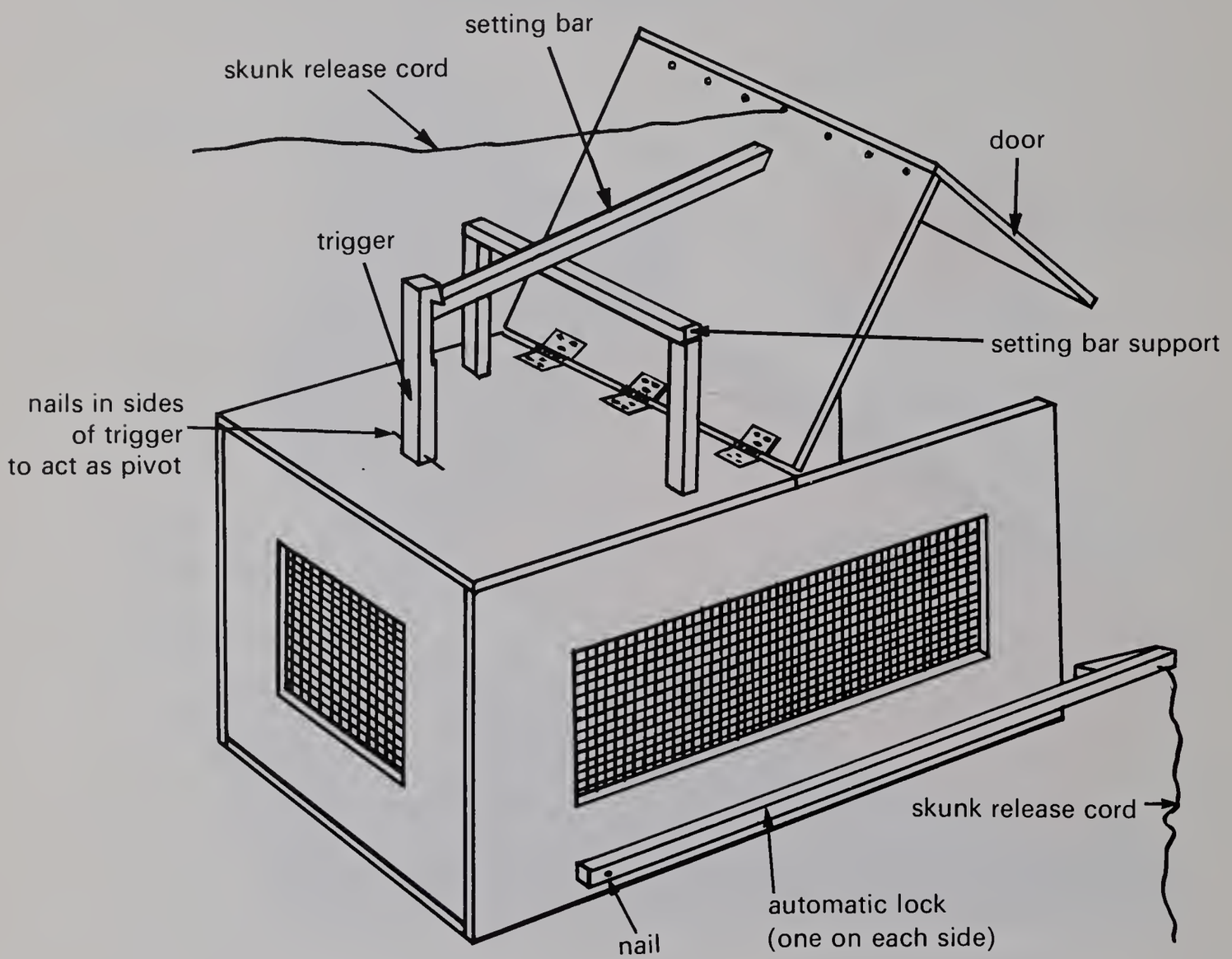
3. Box trap (for medium-sized mammals such as squirrels, rabbits).

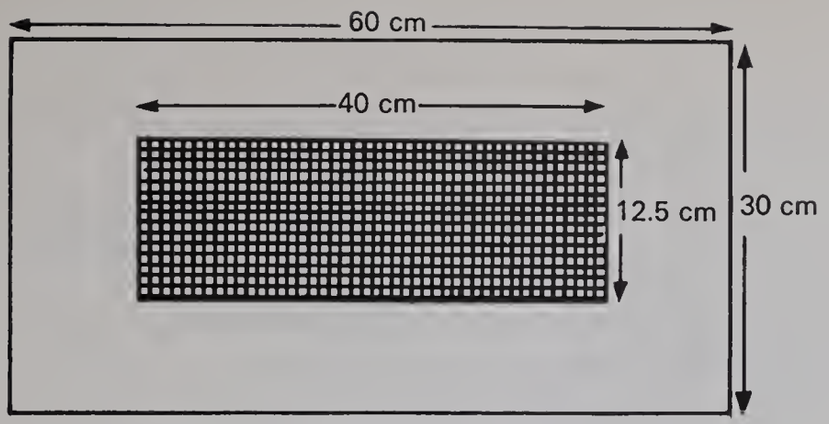


suggested dimensions

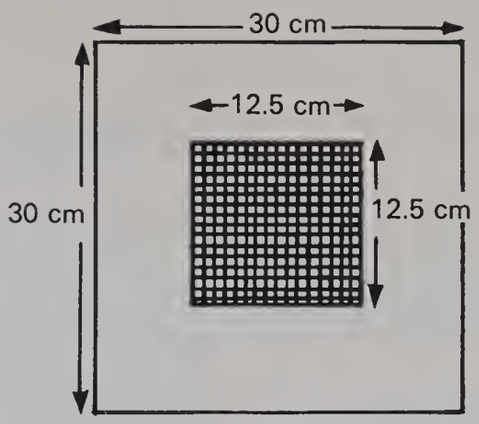
box – 45 cm × 30 cm × 30 cm (10 mm or 15 mm plywood)
hardware cloth – 35 cm × 20 cm (3 mm wire mesh)
base – 55 cm × 40 cm (10 mm or 15 mm plywood)
opening on top – 30 cm × 15 cm

4. Box trap. The dimensions of this trap can be varied to suit individual needs and materials. The detailed plans suggest a trap large enough to catch raccoons and other mammals of similar size. It is recommended that 10 mm to 15 mm plywood be used for construction.

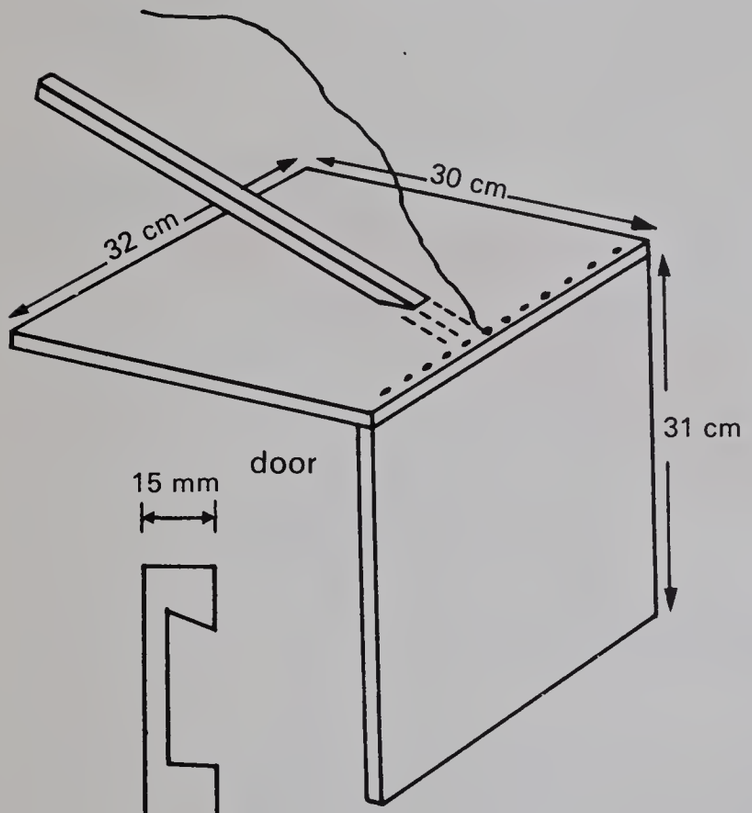


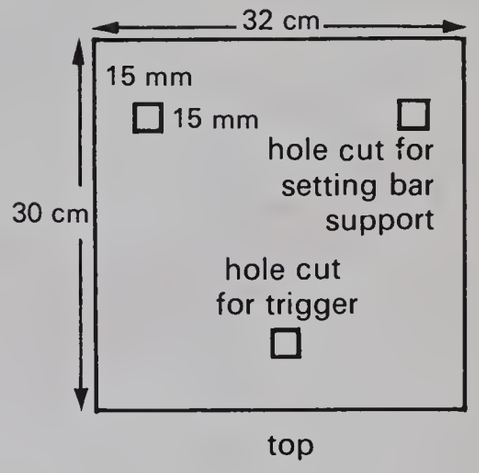

60 cm
40 cm
12.5 cm
30 cm

side

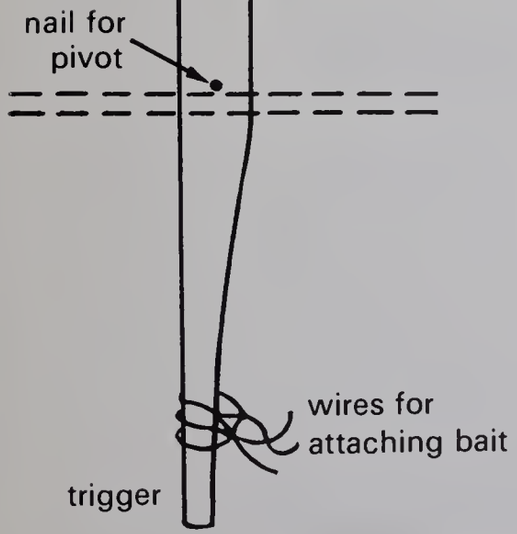

30 cm
12.5 cm
30 cm
12.5 cm

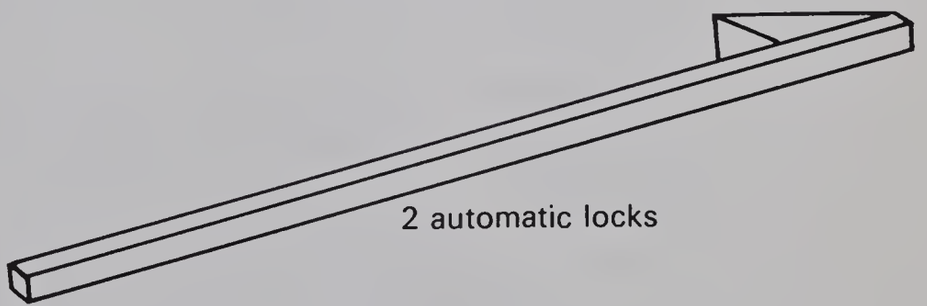
end


32 cm
30 cm
31 cm
door

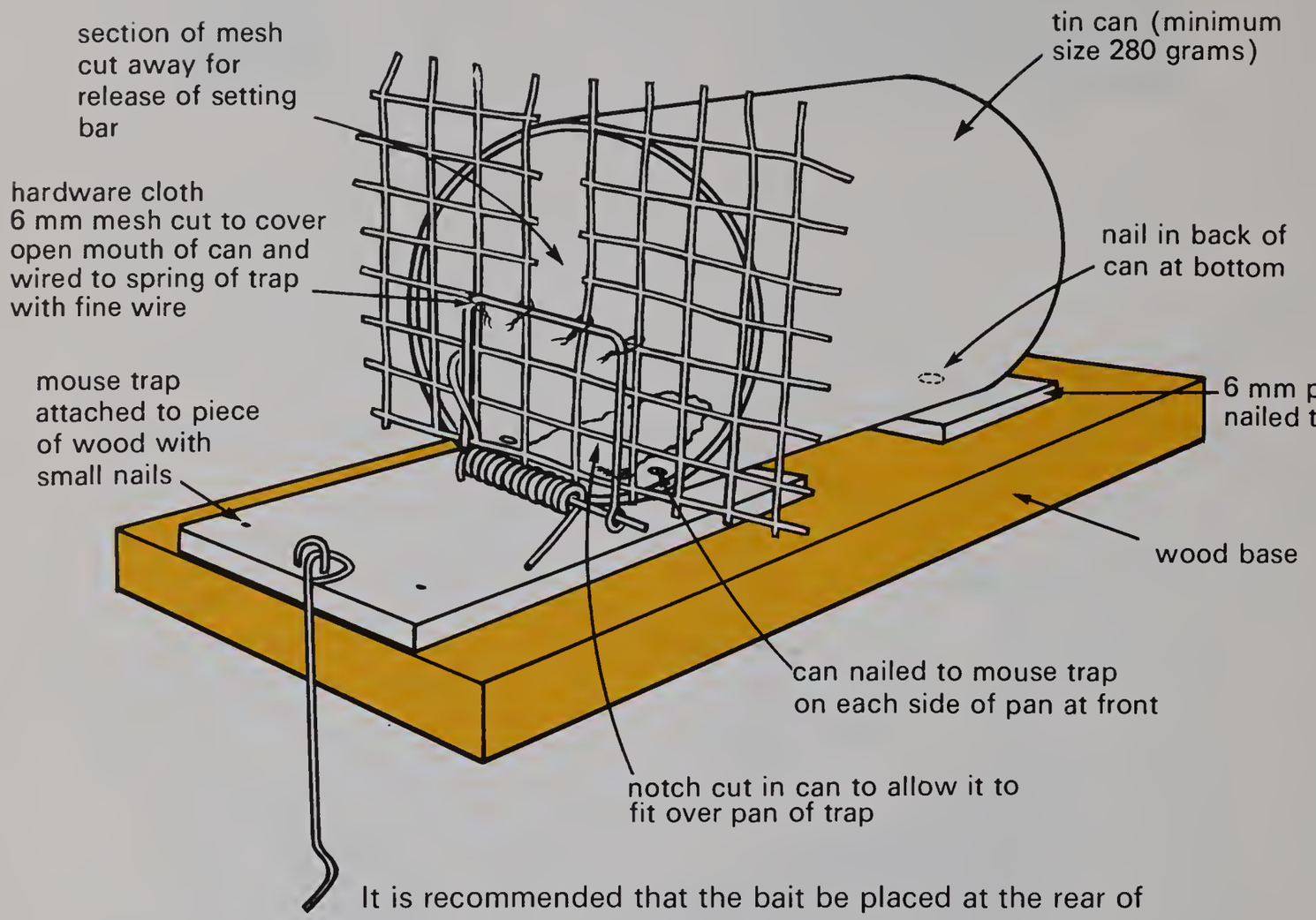

32 cm
15 mm
15 mm
hole cut for
setting bar
support
30 cm
hole cut
for trigger

top


15 mm
nail for
pivot
wires for
attaching bait
trigger


2 automatic locks

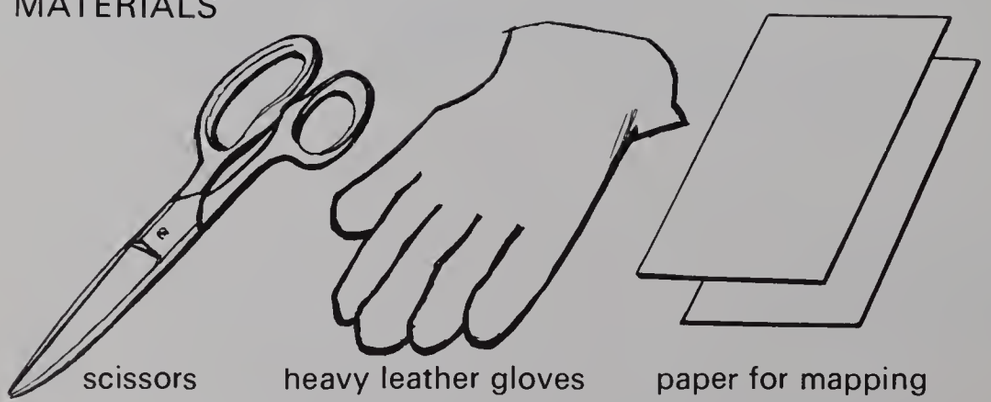
5. Juice can trap.


section of mesh cut away for release of setting bar
tin can (minimum size 280 grams)
hardware cloth 6 mm mesh cut to cover open mouth of can and wired to spring of trap with fine wire
nail in back of can at bottom
mouse trap attached to piece of wood with small nails
6 mm plywood nailed to base
wood base
can nailed to mouse trap on each side of pan at front
notch cut in can to allow it to fit over pan of trap

It is recommended that the bait be placed at the rear of the can and on the pan of the trap. (Small mammal traps are commercially available.)

Activity 2: ESTIMATING MAMMAL POPULATIONS

MATERIALS



scissors heavy leather gloves paper for mapping

1. Consider the open area and decide which mammals you would expect to find.
2. Decide which type of trap would be most suitable for the mammals to be captured.
3. Build the necessary traps. For small rodents, such as mice, 20 to 30 traps are recommended.
4. The following list gives suggestions for baiting traps.
   (a) Mice and other small rodents —mixture of peanut butter and rolled oats
   (b) Rabbits and woodchucks —fresh vegetables
   (c) Raccoons, foxes —meat, fresh fish, dog food
   (d) Squirrels —nuts, peanut butter and rolled oats
   (e) Skunks, opossums —table scraps, meat, dog food

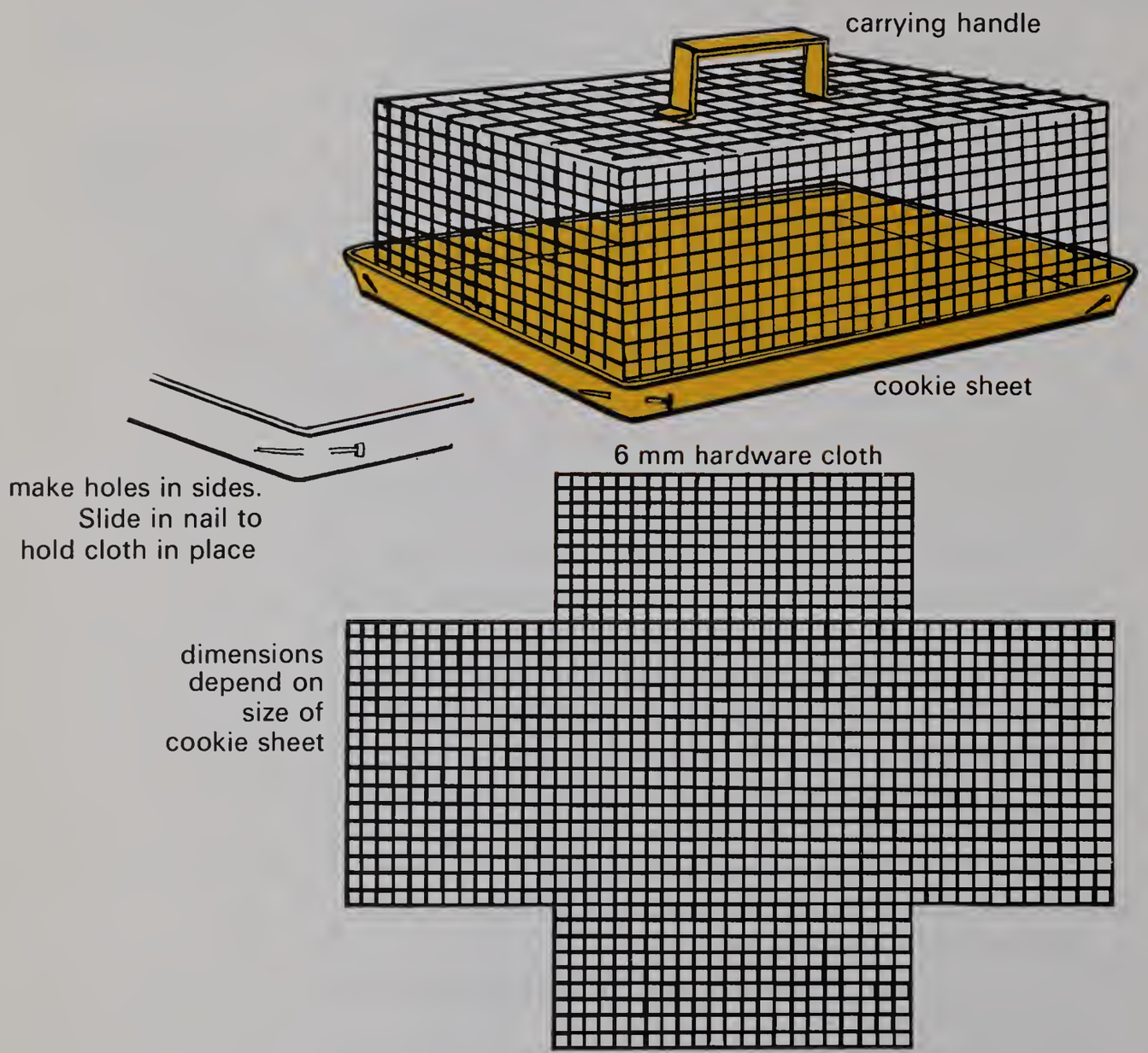
   Experiment with a variety of baits.
5. Set the baited traps in a variety of locations within the area being used for the population count. Best results will be obtained if you set your traps at right angles to and touching animal runways. These tiny trails may be found in heavy or tall grass. Also set some traps:
   (a) near fence posts.
   (b) in sandy areas.
   (c) near walls.
   (d) on or near footpaths.
   (e) on bare ground.
6. Map the locations of the traps. Leave the traps overnight.
7. When the traps are checked the next day, record the total number of animals caught and trim a little hair from the back of the neck. Heavy leather gloves should be worn during this procedure to prevent injury from bites. Where were most animals trapped?
8. Release all the marked animals and reset the traps for another count the next day.
9. To estimate the population, use the method described on pages 35 and 36.

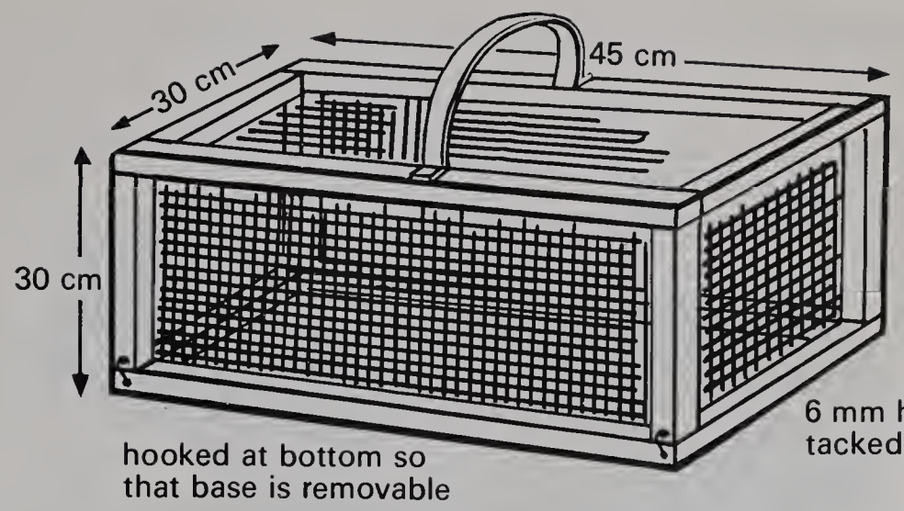
Never leave traps unattended for more than one night. Traps made to catch shrews should be checked every two hours during the day due to shrews' constant need for food.

Activity 3:
MAKING MAMMAL CAGES

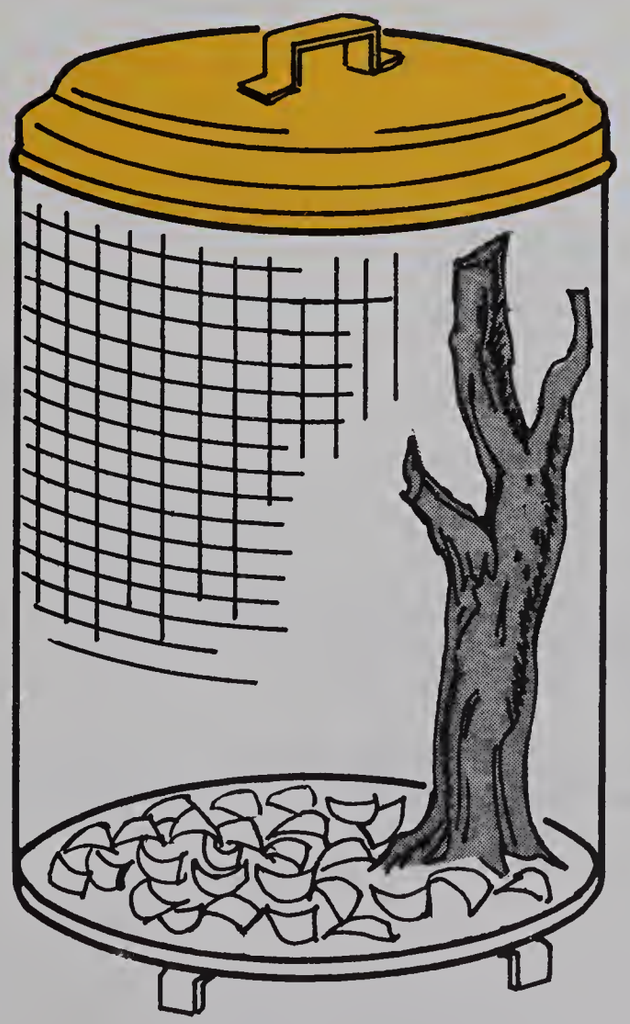
Suitable cages need to be built if you are to keep mammals in the classroom. Below you will find some examples that you can make.

1. The first two cages are suitable for rabbits, hamsters and gerbils.


carrying handle
cookie sheet
make holes in sides. Slide in nail to hold cloth in place
6 mm hardware cloth
dimensions depend on size of cookie sheet



2. For squirrels.

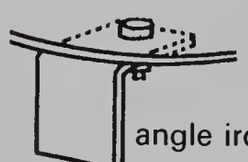


use metal garbage can lids for top and bottom. Attach top and bottom to lids with fine wire

weight bottom of cage with cement or stones

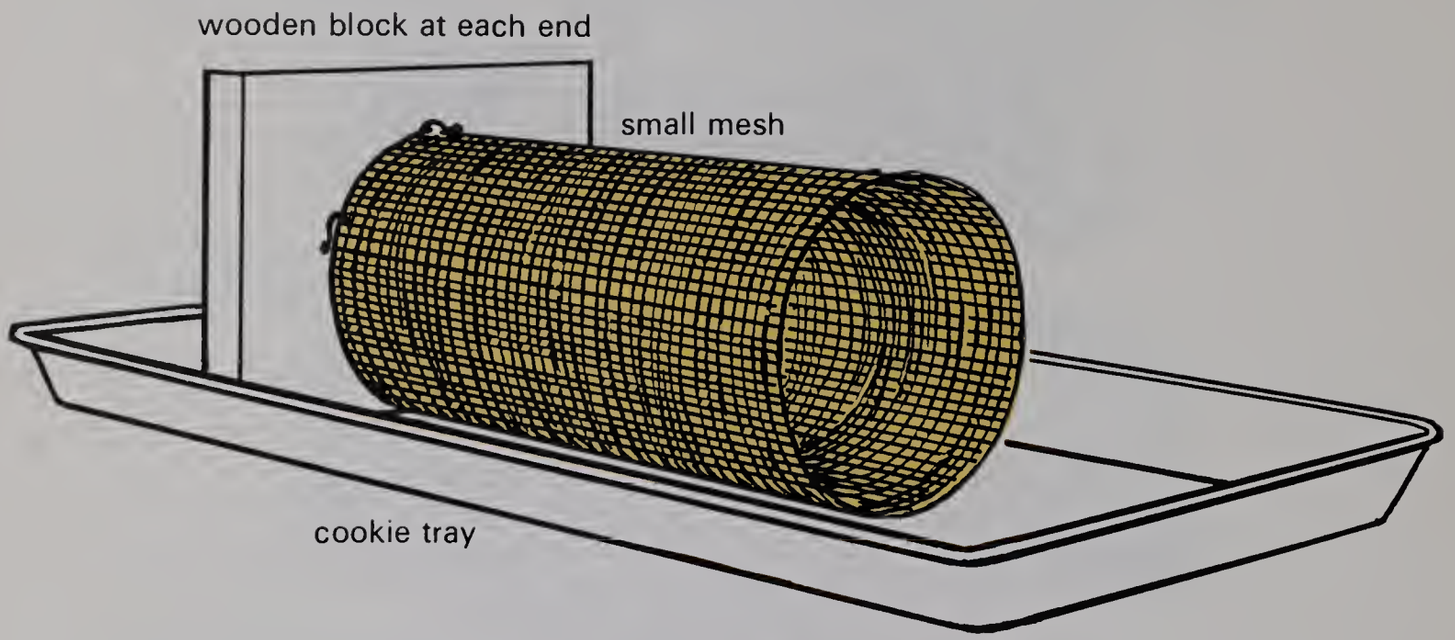
drill hole for wiring cloth to base and top

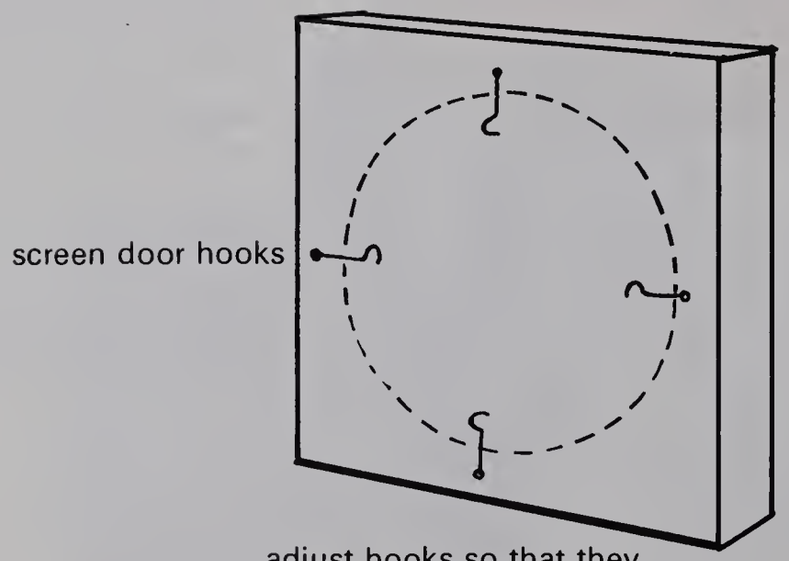
height of cage may be varied to suit the size of mammal



legs bolted on the bottom

3. For mice.



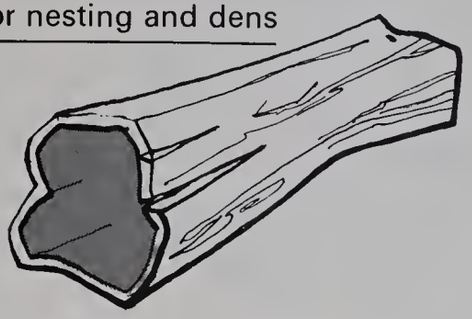


adjust hooks so that they
catch snugly on the mesh

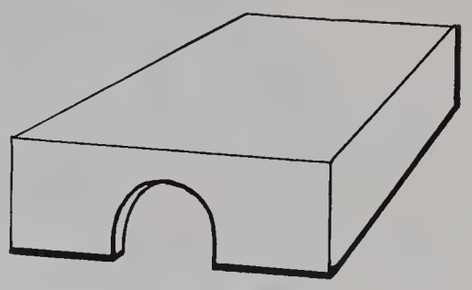
bend fine hardware cloth to form a
smooth collar. Sharp edges may injure mammals

The following materials are useful in making the animal's home as natural as possible.

for nesting and dens

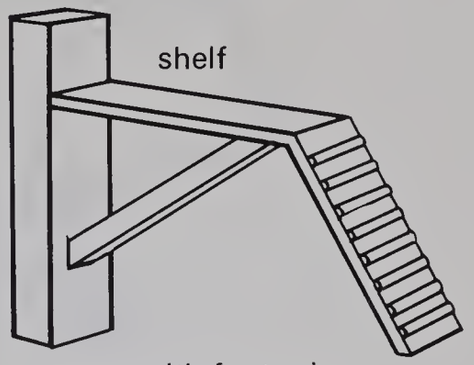


piece of hollow log

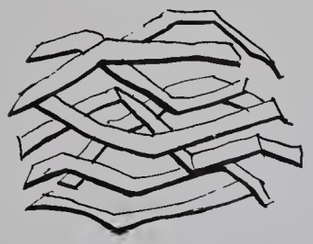


small wooden box

rock shelter

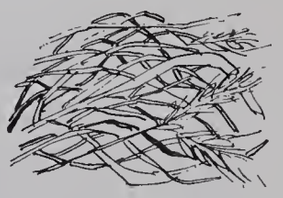


ramp with foot grips

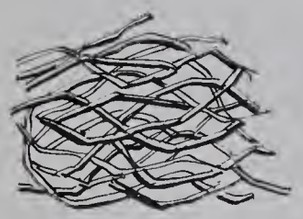


shredded paper

wood shavings

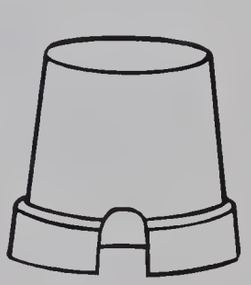


hay



straw

litter pan containing sawdust or sand

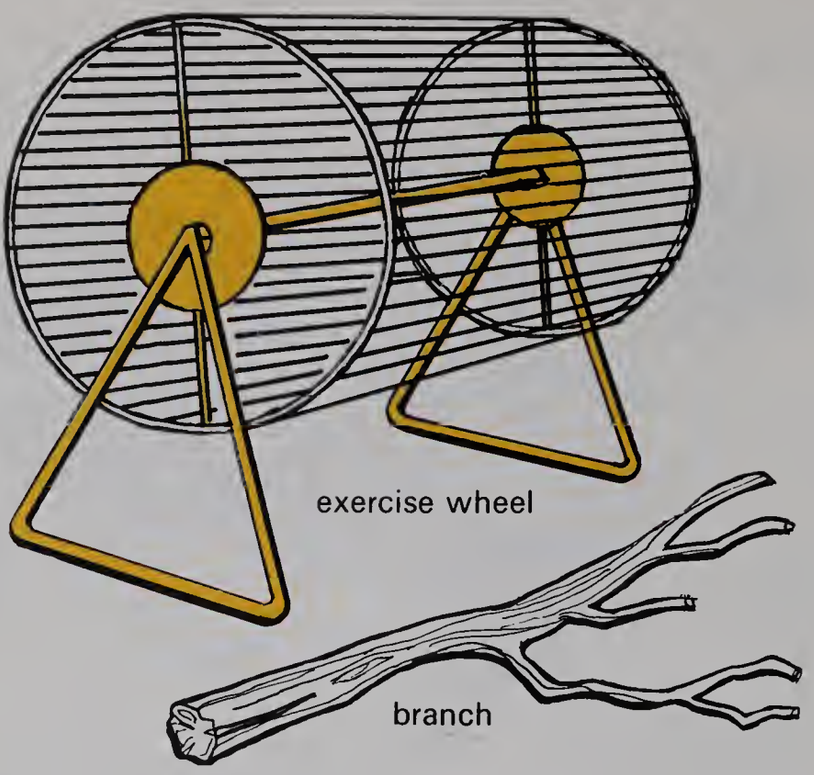


paper mache pot

for feeding.

Why should the container be low and heavy?

for activity



CARE OF MAMMALS

1. How often should your animals be fed?
2. What food is best?
3. How should the cages be cleaned? How often?
4. How can you prevent an animal from gnawing its way out of a cage?
5. Baby animals require special care. Why?
6. Find out the correct way to handle animals.

Other Activities

1. What may be learned from a study of animal tracks and signs?
2. What animals eat affects them. How? Design experiments to demonstrate the effects of a balanced and unbalanced diet.

3. How are animals adapted to their environments?
4. How do animals learn? Build mazes for mice and rats and set up learning experiments.
5. Try breeding mice or some other small animal.
6. Animal photography.
7. Man is a mammal. Compare your small animals and man. How are they similar and different?

The Companion book, Mammal Studies, contains further ideas and activities.

Furry, striped friend with mumps
Who caches berries under stumps,
How do you fare beneath the snow
When wintry blasts begin to blow?
I watched your summer's scurried reaping
Of seeds and nuts and, for your sleeping,
Mouthfuls of leafy bits and bark
To keep you snug in frigid dark.
They say you doze 'til winter's past,
That though you hoard enough to last
For several seasons underground,
There's plenty left when spring rolls 'round.
Why, then, insist on frenzied forage
When half as much is ample storage?

Who am I?

PLANTS

INTRODUCTION

The life of man is closely connected with plants. How does man depend upon plants? List as many ways as you can which show this link between man and plants.

Activity 1: PLANT GROUND COVER

METHOD

Go to an open place to estimate the amount of ground covered by different plants. Work in groups and make several sample plots.

1. Select a suitable method for taking samples from those outlined in the section Hints for Sampling found on pages 14 to 19.
2. Collect a specimen of each different plant found in the sample plots and label them 1, 2, 3, ... The naming of plants is not necessary here. Take a limited number of specimens back to the classroom for further study and comparison.
3. What fraction of the sample plot was covered by each plant type?
4. Record your findings in your record book. Your results may show something like this:

PLANT LIST	APPROXIMATE AMOUNT OF GROUND COVERED
1	one-tenth
2	two-tenths
3	four-tenths
4	two-tenths
5	one-tenth

5. In the same way, record the results from several sample plots.

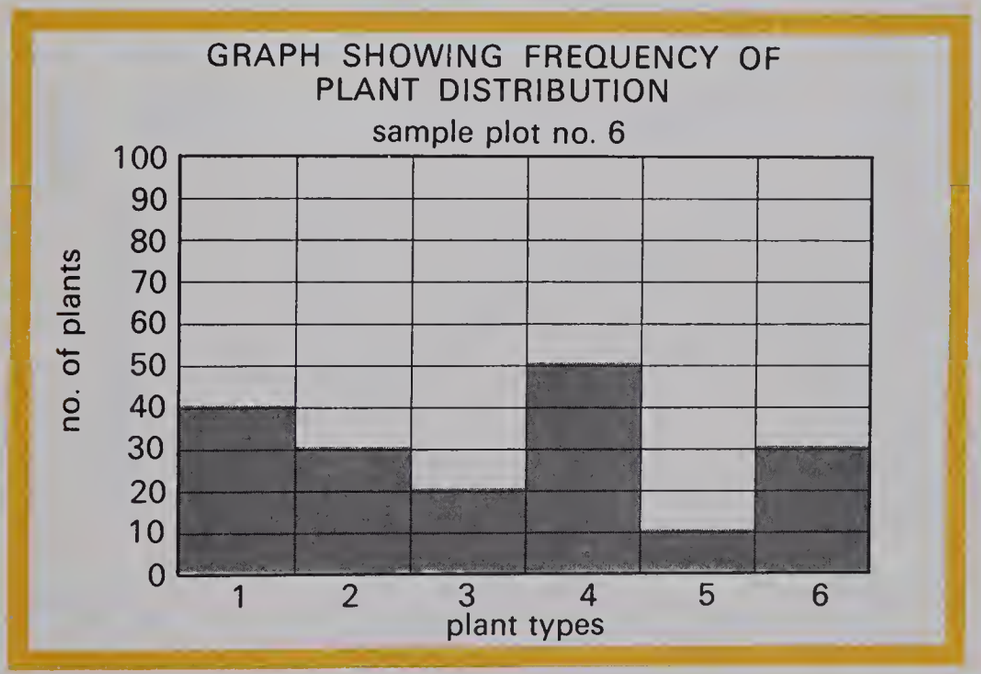
6. Return to the classroom and standardize your labelling system so that all pupils give the same plant the same number.
7. Combine all results to estimate how much of the open area is covered by plants 1, 2, 3, ...

Activity 2: PLANT DISTRIBUTION

Now that you have an idea of the amount of ground which is covered by the different plants in the open area, estimate the frequency distribution of each plant type.

METHOD

1. In the open area take sample plots by throwing the ropes.
2. In the sample plots count the number of plant 1 that you find. Express the results by using a graph (a picture) similar to the one on this page.
3. Combine all the data to make a class graph.
4. Compare the small group and class graphs and explain differences.



Bring in anything to class that you think is a plant. List points to describe what you mean by the word plant. Compare your lists with classmates. Do your points fit all plants? Why not?

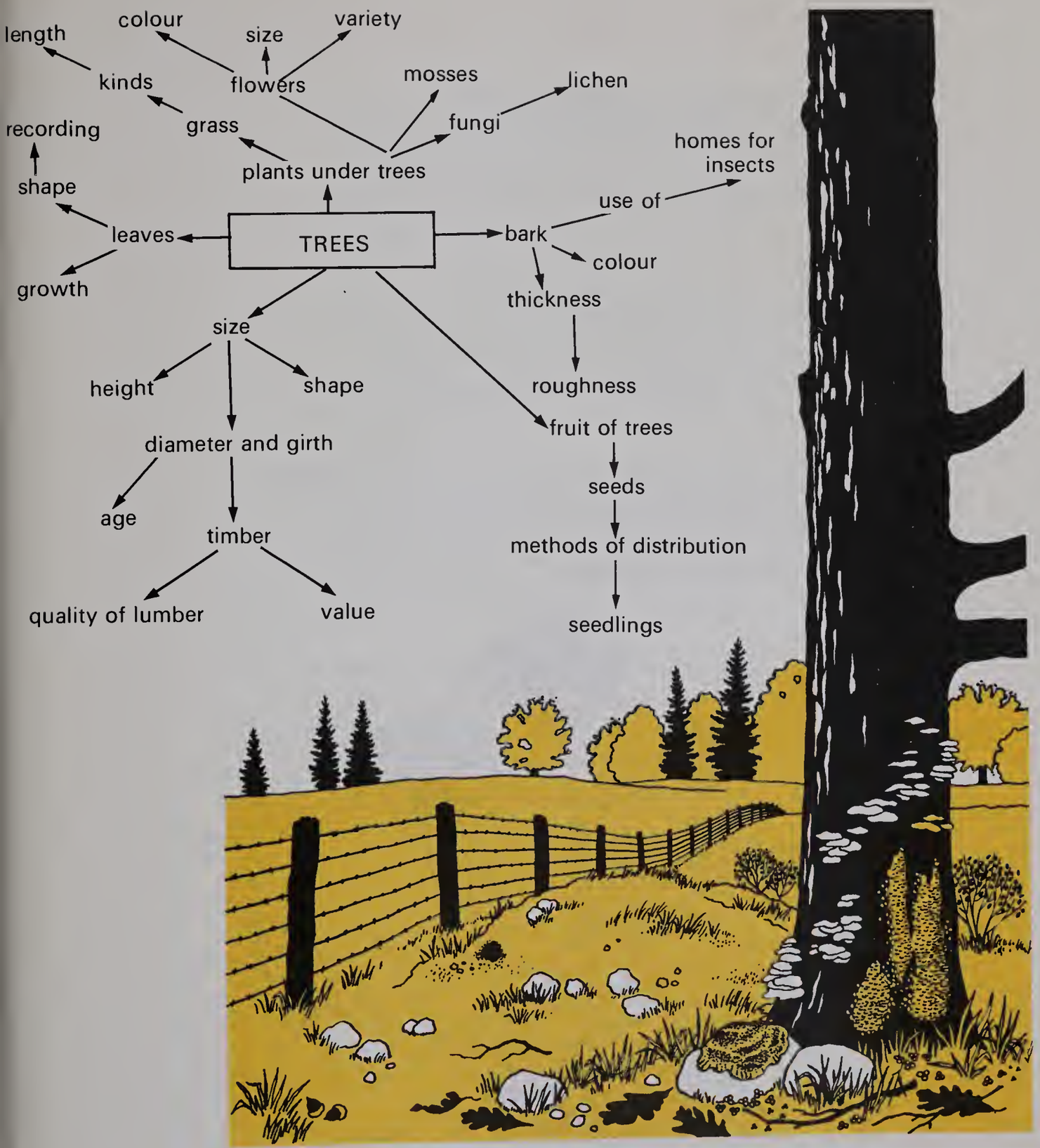
Other Activities

1. What factors affect the growth of plants?
2. How does plant distribution vary?
3. Sketch plants on your field trips, to help in identification.
4. What are the main functions of the parts of a plant?
5. How do seeds travel?
6. Photograph wild flowers.
7. What is a weed?
8. Make a study of food crops and the areas of the world in which they are grown.
9. How do plants reproduce?
10. Plant microscopy.
11. Find out how to force winter buds.

SUGGESTIONS FOR CLASS DISCUSSION

1. Life on earth depends upon plants. Explain.
2. There are many connections between plants and animals. One of these is in the way plants provide nesting sites. Name as many animals as you can which nest in trees, shrubs, grass and field layers, and water plants.
3. How do plants defend themselves against animals?
4. How is a leaf like a factory?
5. What causes plants to be different colours?

More ideas and activities are in the companion book, Plant Studies.


TREES
kinds
length
flowers
colour
size
variety
grass
recording
plants under trees
mosses
fungi
lichen
shape
leaves
growth
bark
use of
homes for insects
colour
thickness
roughness
size
height
shape
diameter and girth
age
timber
quality of lumber
value
fruit of trees
seeds
methods of distribution
seedlings

DANDELION

"Oh dandelion, yellow as gold,
What do you do all day?"
"I just wait here in the tall green grass
Till the children come to play."

"Oh dandelion, yellow as gold,
What do you do all night?"
"I wait and wait till the cool dew falls
And my hair grows long and white."

"And what do you do when your hair is white,
And the children come to play?"
"They take me up in their dimpled hands,
And blow my hair away."

TREES

Trees are the kindest things I know,
They do no harm, they simply grow

And spread a shade for sleepy cows,
And gather birds among their boughs.

They give us fruit in leaves above,
And wood to make our houses of,

And leaves to burn on Hallowe'en,
And in the Spring new buds of green.

They are the first when day's begun
To touch the beams of morning sun,

They are the last to hold the light
When evening changes into night,

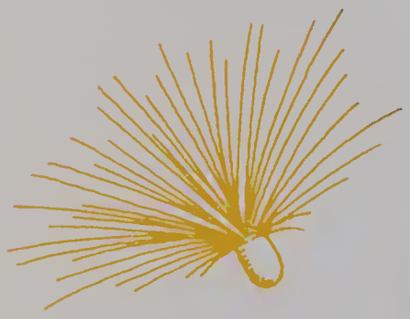
And when a moon floats on the sky,
They hum a drowsy lullaby

Of sleepy children long ago . . .
Trees are the kindest things I know.

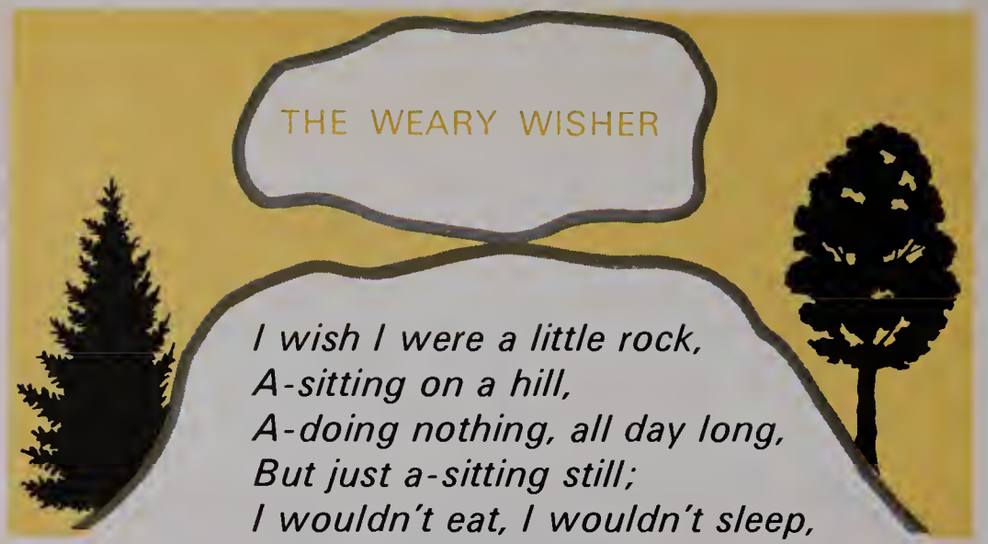
BABY SEED SONG

Little brown brother, oh! little brown brother,
Are you awake in the dark?
Here we lie cosily, close to each other:
Hark to the song of the lark—
"Waken!" the lark says, "waken and dress you;
Put on your green coats and gay,
Blue sky will shine on you, sunshine caress you—
Waken! 'tis morning—'tis May!"

Little brown brother, oh! little brown brother,
What kind of flower will you be?
I'll be a poppy—all white, like my mother;
Do be a poppy like me.
What! you're a sunflower? How I shall miss you
When you're grown golden and high!
But I shall send all the bees up to kiss you;
Little brown brother, Good-bye.



SOIL



I wish I were a little rock,
A-sitting on a hill,
A-doing nothing, all day long,
But just a-sitting still;
I wouldn't eat, I wouldn't sleep,
I wouldn't even wash—
I'd sit and sit a thousand years,
And rest myself, b'Gosh.

Frederick Palmer Latimer

Will the little rock's wish come true?
What might happen in the meantime?

INTRODUCTION

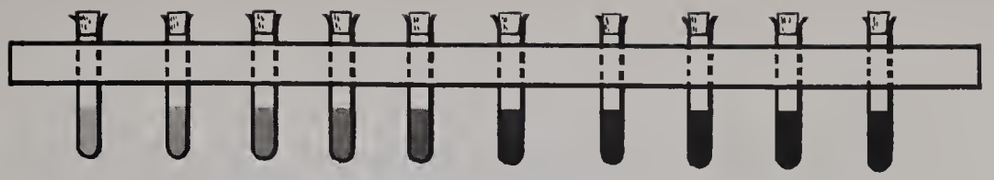
Before you visit the site to begin your studies, write a description of soil in your record book. This should include as many things as you know that would help someone else understand what is meant by the word soil.

Activity 1: A COLOUR GUIDE

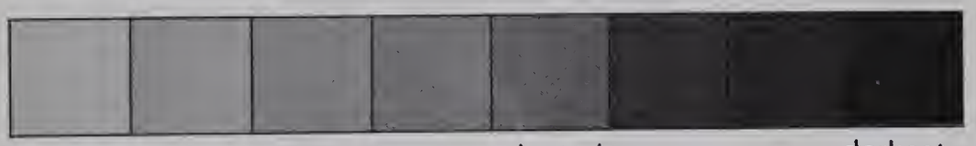
METHOD

Why do soils show a wide variation in colour? To answer this question, you might begin by examining a number of soil samples. If the findings are to be recorded, some standard for comparison will be necessary. A device to measure the colour of soil can be prepared in the following way.

1. Each member of the class should collect as many differently coloured shades of soil as can be found. These might be gotten on a weekend before the soil studies are begun at school.
2. Compare the samples with those of classmates.
3. Divide the samples into as many colour shades as can be noticed.

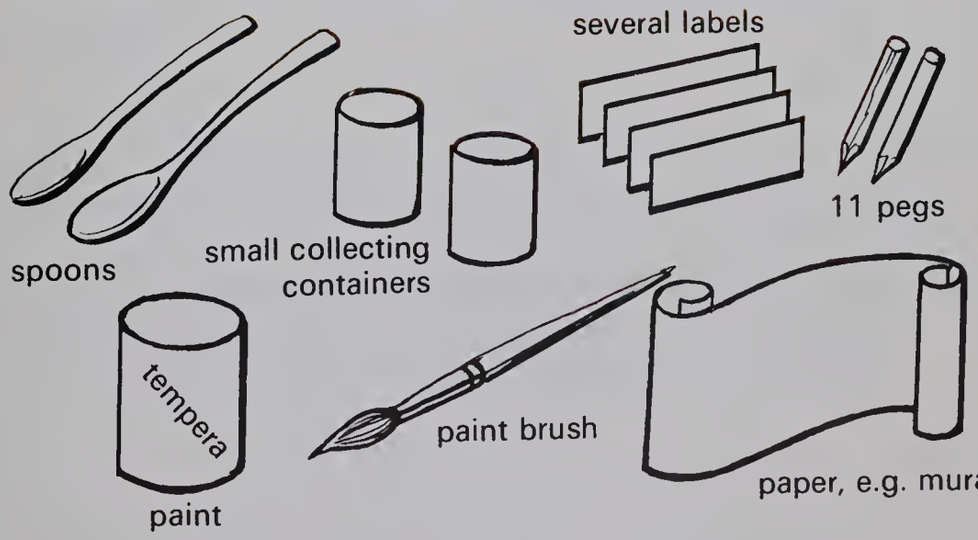


4. Arrange the colours in order from lightest to darkest. One class arranged their different colours as shown in the drawing above. The corks were placed in the test tubes so that the apparatus could be used as a permanent guide.
5. Determine some way of identifying each colour in the guide. The guide in Figure 1 used numbers for this purpose. A girl in another class used 12 different names to identify the different colours she found. These included light cinnamon, golden cinnamon, dark cinnamon, light brown, medium brown, dark brown, and so on.
6. Additional colour guides might be prepared for use outdoors or in the classroom by:
   (a) dampening each differently coloured sample of soil and smearing it on paper with the thumb.
   (b) mixing paint to correspond to each colour and making a colour graph by filling in the blocks on a separate strip of paper. See the graph below.



Activity 2: COLLECTING SAMPLES FOR COLOUR COMPARISONS

MATERIALS



The purpose of this activity is to compare the colour of soil samples found within 2 cm of the surface of the ground at various locations. At the conclusion of sampling it will be necessary to discuss the variety or lack of it in soil colour. For this reason, good record keeping is needed.

1. Prepare a map of the chosen site that is sufficiently large to enable the locations from which samples were taken to be marked at a later time. Refer to the suggestions for mapping on pages 11 to 13.
2. Use the suggestions for taking samples outlined on pages 14 to 19.
3. Decide upon some method of choosing the sample locations.
4. Using the colour guide or the colour graph on page 67, identify the colour of soil at each location.
5. Make careful records of both the colour and the location. If, for instance, you were using the peg system the record of your sampling might look like this.

PEG #	COLOUR
1	#4
2	#4
3	#5
⋮	⋮
50	#7

or

PEG #	COLOUR
51	light cinnamon
52	medium brown
53	indian red
⋮	⋮
100	golden brown

Figure 1

6. Plot the colour of the soil at its corresponding location on the map. This could be done with numbers or names, but the use of colour would be better.
7. Discuss your findings. What patterns appear to develop? Explain. What other types of records would help to explain your results?

Activity 3:
COMPARING SOIL COLOURS ON HILLSIDES

This activity is included for making colour comparisons as sampling proceeds from high ground to low areas and between surface soils on hillsides and on level areas in the same general location.

METHOD

1. Pick the highest point of land to be found inside the boundaries of your site, and place a peg in the ground to mark the location. Then select the lowest point and put in another peg. These pegs should be a considerable distance apart (at least 100 metres, if possible).
2. Call the first peg "H" (high) and the second peg "L" (low).
3. Find the number of steps it takes to get from "H" to "L".
4. Divide the distance between "H" and "L" into 10 equal parts. This could be done by pacing (exact accuracy is not important). Mark each tenth of the distance with a peg. See Figure 2.

Figure 2

5. Move from "H" toward "L" and take a sample near each peg. Do not take samples from deeper than 2 cm and make records using the colour guide similar to those that were made for Activity 2.
6. Record your findings on a map.

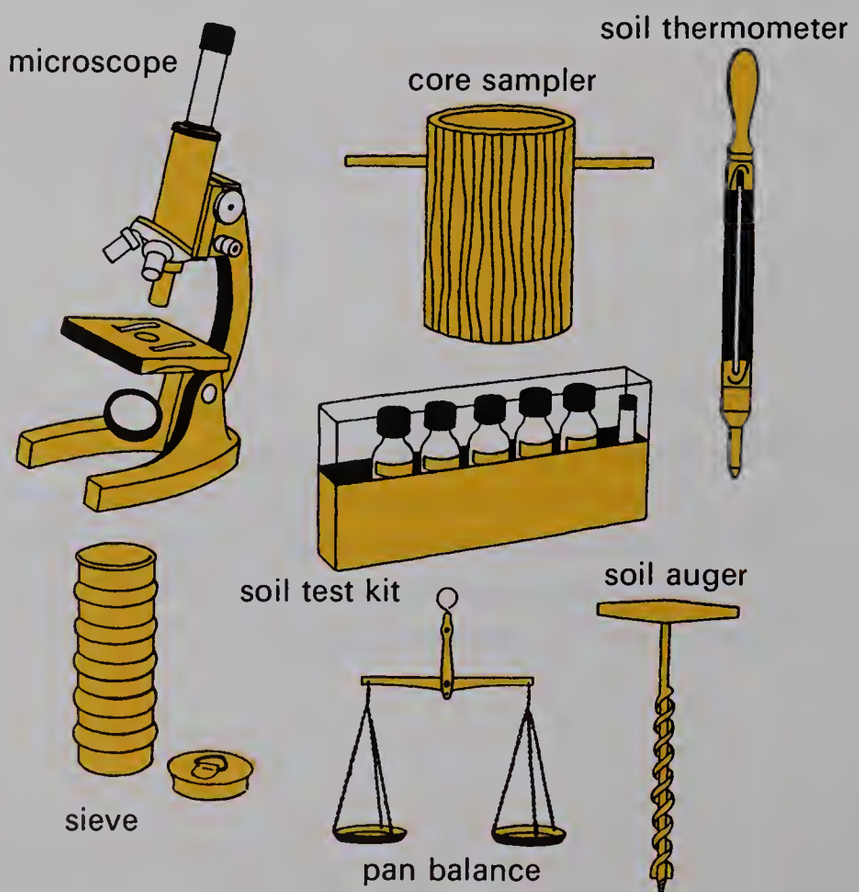
7. Consider the following statements.
   (a) The colour of the soil near the surface depends on its location.
   (b) The colour of surface soil does not seem to depend on location.
8. Suggest questions that might be answered by other experiments. Are there any general laws that could be formulated?

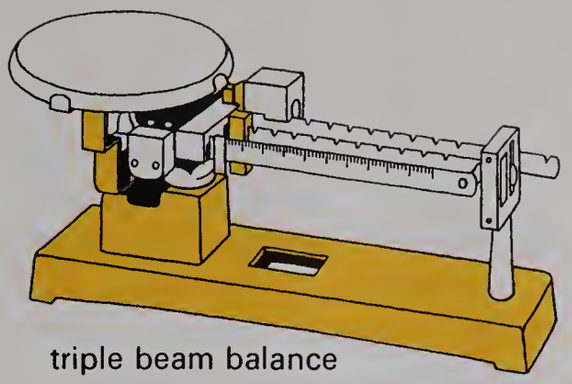
Other Activities

The previous activities with soil studies have only dealt with colour of surface soils. It is hoped that working through these activities has developed an interest in working with real things to search for answers to real problems.

The following activities are listed for those who wish to make further inquiries into the properties of soil. These may be done immediately or left for some later date. Time schedules and amount of detail must be worked out with your teacher. If you do choose to continue, work to develop good scientific methods of researching. Refer to your previous work and to other sections of this book when guidance is

HELPFUL MATERIALS





triple beam balance

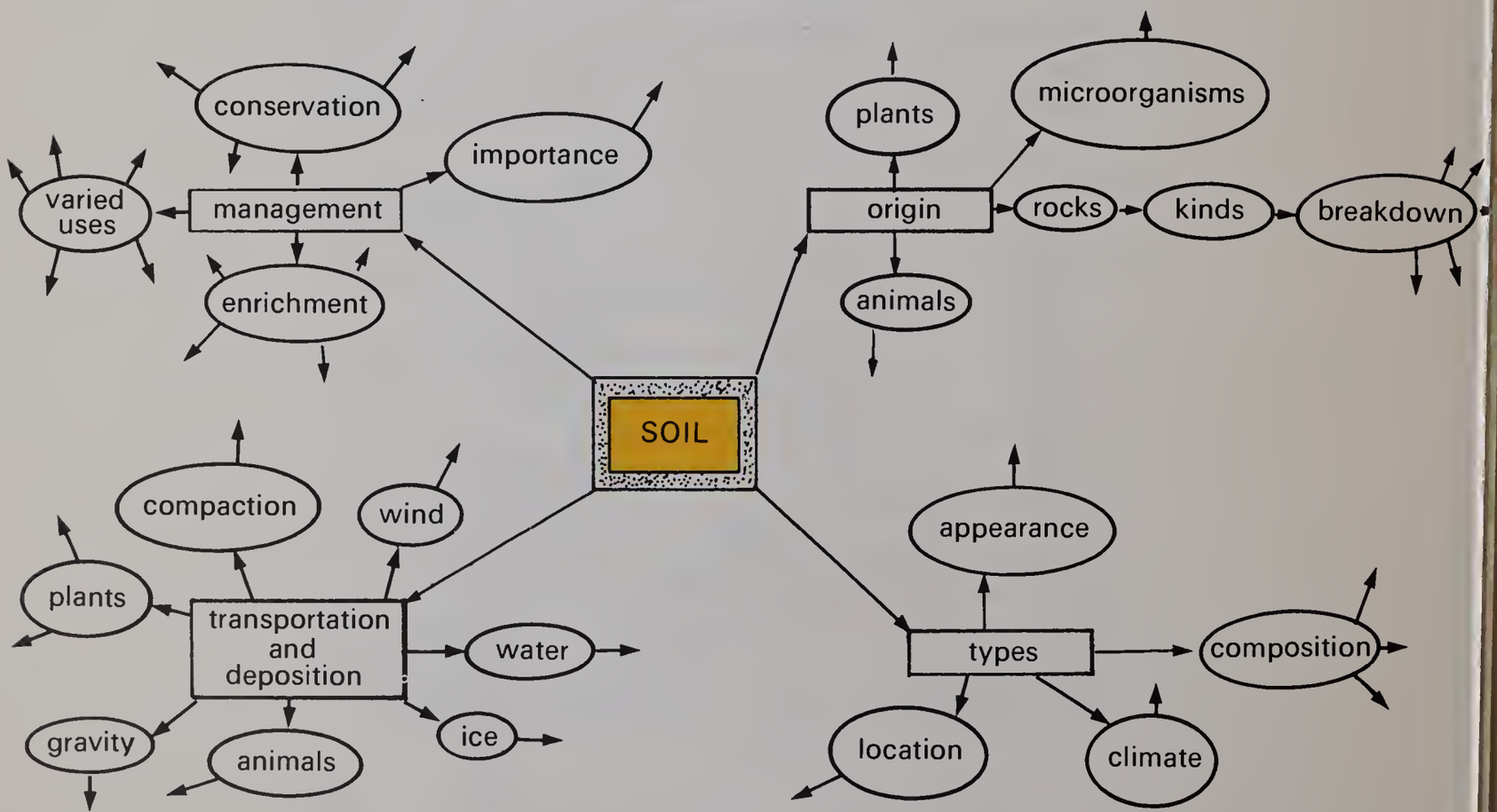
shovel

necessary. The Companion book, Soil Studies, gives suggestions for other activities, as well as information on soil.

1. How do sub-soils and surface soils differ? What changes occur in soils as the depth from which they are taken changes?
2. Did your studies reveal soils of different grain sizes? Does the grain size change as you move along the surface of the area? If differences are found at the surface, record your findings on a map. What are the relationships between the grain sizes at the surface and those found by digging to lower levels? Devise methods for separating the different grain sizes.
3. Make a chart to show any relationship that may exist between soil colour and grain size. Express the meaning of your findings in your record book.
4. Find an area in which you can dig a soil profile, as described in the Companion book, Soil Studies.
5. What is the origin of all soil? Find evidence to support your answer. Identify the soil-producing forces.
6. Sketch some of the different shapes that may be found when a sample of soil is examined under a microscope. Find names for these different shapes.
7. Name as many different soils as you can find. Group the components into categories. Compare your results with:
   (a) those of your classmates.
   (b) those in the Companion book, Soil Studies.
8. Find evidence to show that soil is continually being transported. What are the agents of transportation? How may this movement of soil affect men's lives?

9. Devise experiments to show that most soil samples contain water when they are removed from the ground. How can water be removed from soil? How does this removal affect the weight? Compare the amount of water, by weight, in different kinds of soil. Test the water-holding capacity of different types of dried soil. Who will be most interested in these findings?
10. What appears to cause variations in the temperatures of soil?
11. What relationships can be seen between soil colour, grain size, location, temperature and composition, and the origin of soil?
12. Investigate the importance of soil management.

The following flow chart suggests possible areas of inquiry into soil. Can you think of others? For how many arrows can you supply additional suggestions for further study?



STREAMS

INTRODUCTION

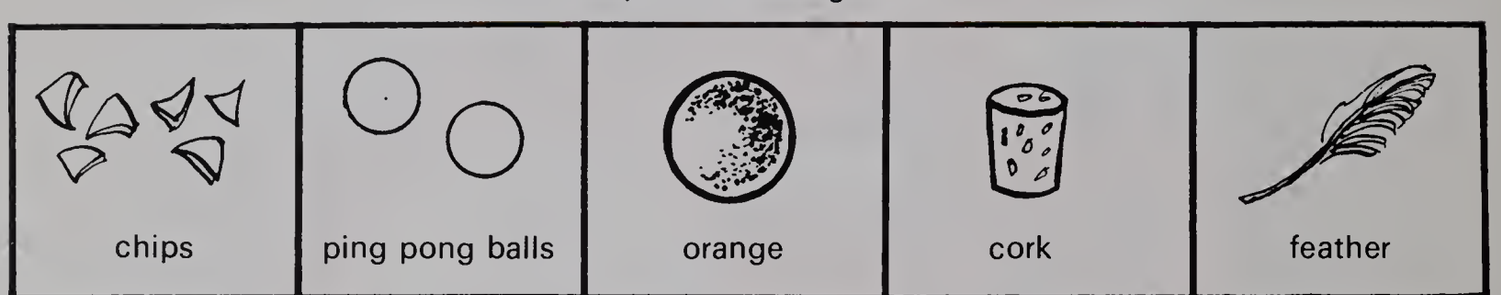
The stream offers many science experiences. A stream may begin from a spring. As it flows downhill, the stream gathers more water, becomes larger and may become a river. On its way to the ocean, the stream may run into a low spot to form a pond.

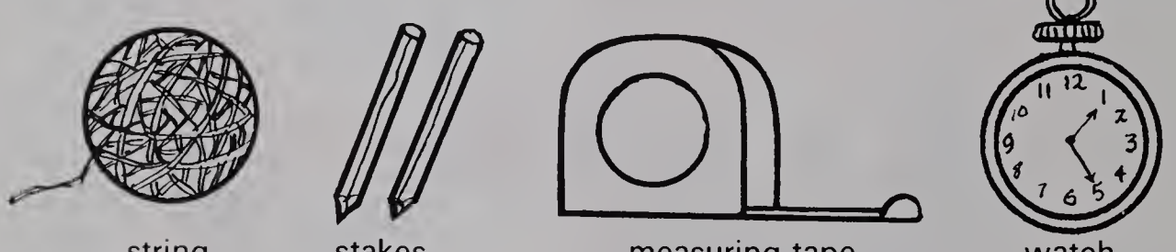
In this unit, only one activity is outlined. This will get you started in stream work. Study the charts on the following pages for other situations which you can investigate.

Activity 1: RATE OF FLOW

MATERIALS

samples of floating debris

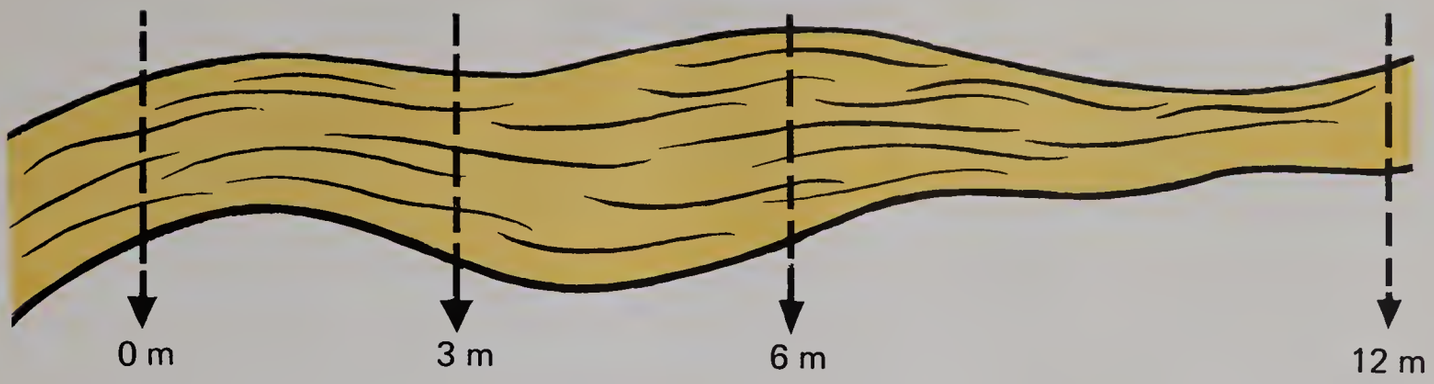




string stakes measuring tape watch

METHOD

1. Along the edge of the stream, stake out sections measuring 3, 6, and 12 metres in length.



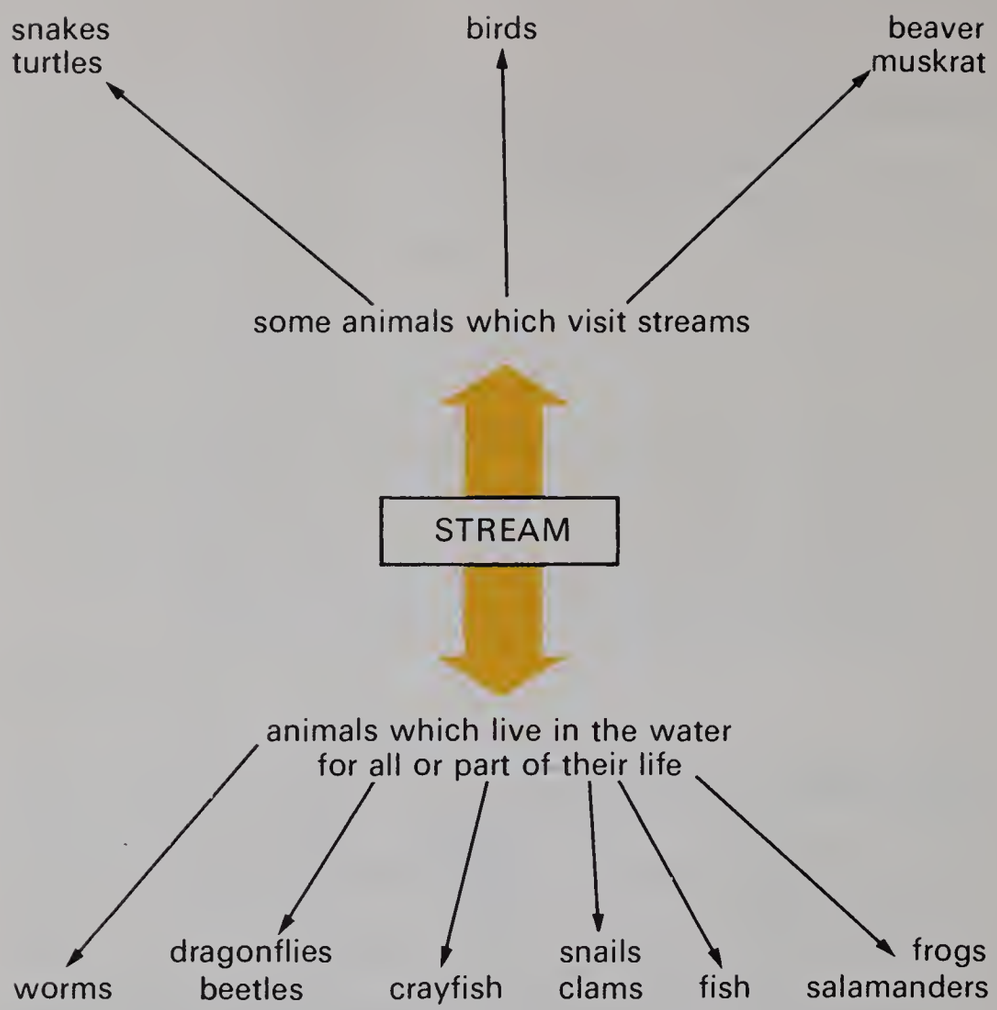
2. Use the 0 metre stake as a starting point, release one of the samples of floating debris and record the time it takes to reach the 3, 6, and 12 metre markers. Repeat this several times to calculate the average time. Work with different types of floating debris.

PROBLEMS TO INVESTIGATE

1. Why should debris be released at different distances from the shore?
2. What do you note about the speed of the current near the centre of the stream compared with close to the bank?
3. How do depth and width affect the rate of flow?
4. What effect do wind direction and speed have on the rate of flow?

For comparisons, the Companion book, Stream Studies, contains results obtained by other pupils.

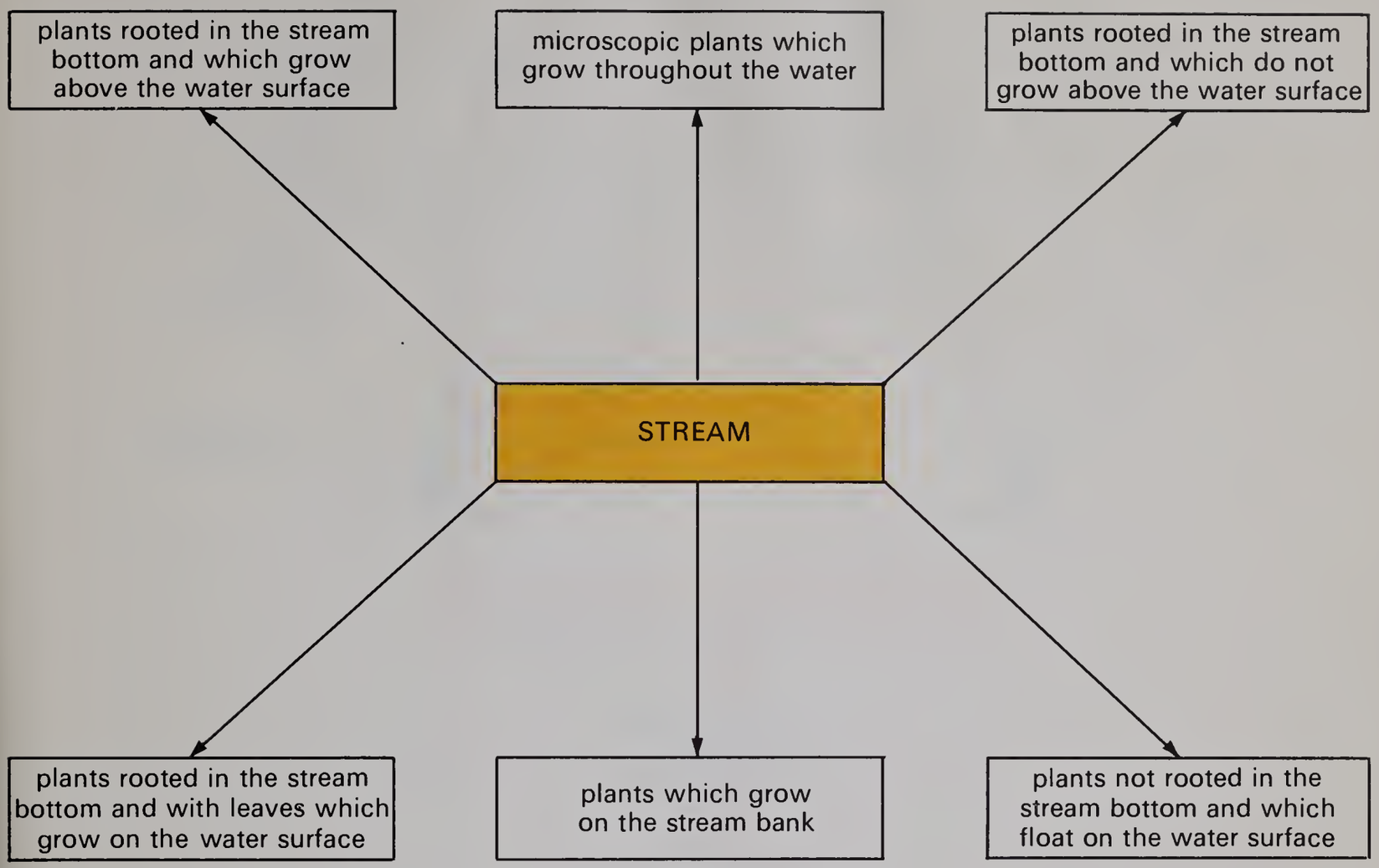
ANIMAL FACTORS



Here are some problems you may wish to investigate. In the Companion book, Stream Studies, you will find ways of discovering the answers to these.

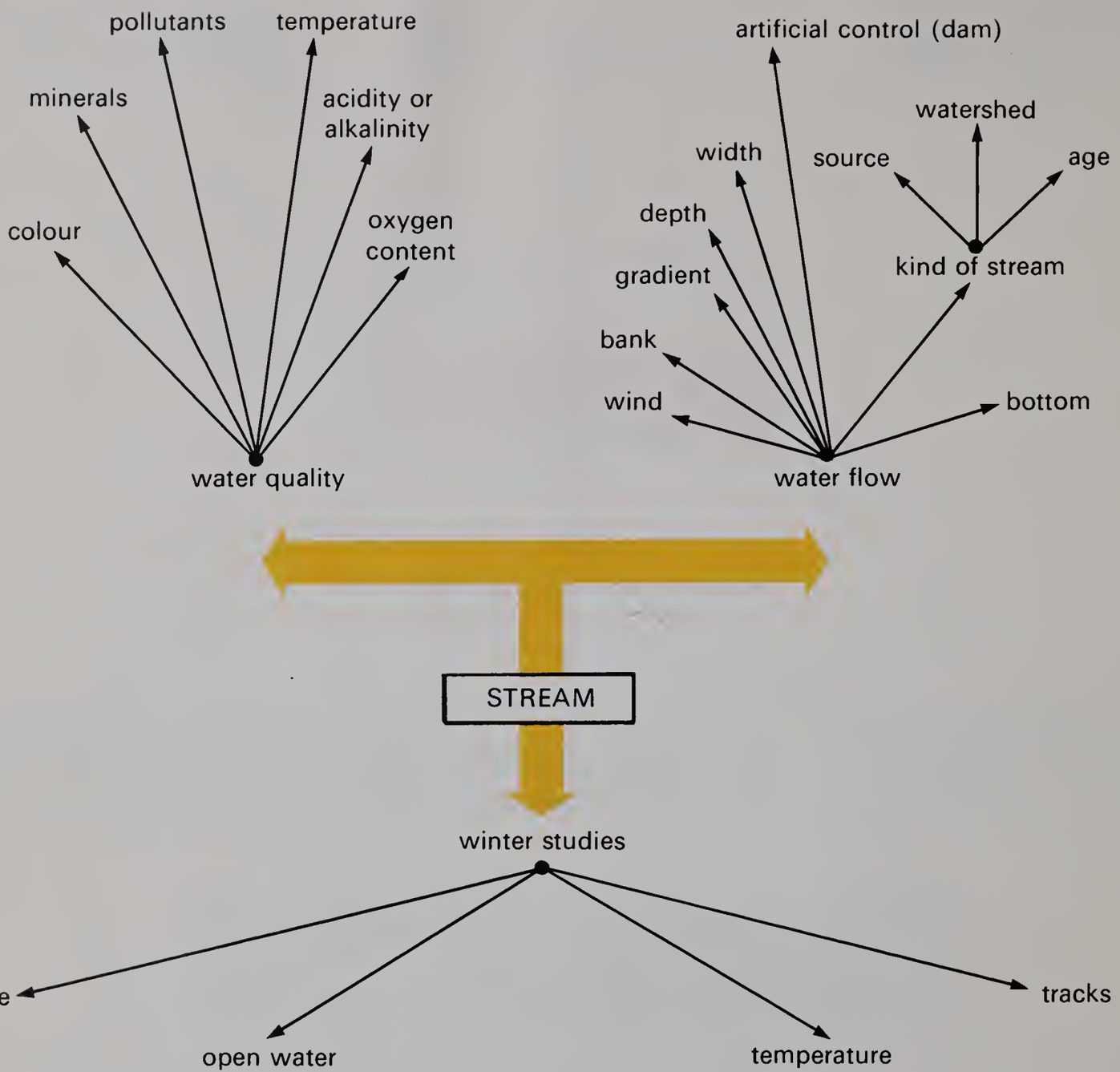
1. In what part of the stream is the animal found? Why?
2. How does the animal breathe?
3. How does the animal move?
4. What food does the animal eat?
5. What other animals live upon the animal you are studying?
6. How do you care for your animal in the classroom?

PLANT FACTORS


plants rooted in the stream bottom and which grow above the water surface
microscopic plants which grow throughout the water
plants rooted in the stream bottom and which do not grow above the water surface
STREAM
plants rooted in the stream bottom and with leaves which grow on the water surface
plants which grow on the stream bank
plants not rooted in the stream bottom and which float on the water surface

1. Try to find at least one example for each of the six types of plant presented in the chart.
2. In what ways are animals dependent on these plants?

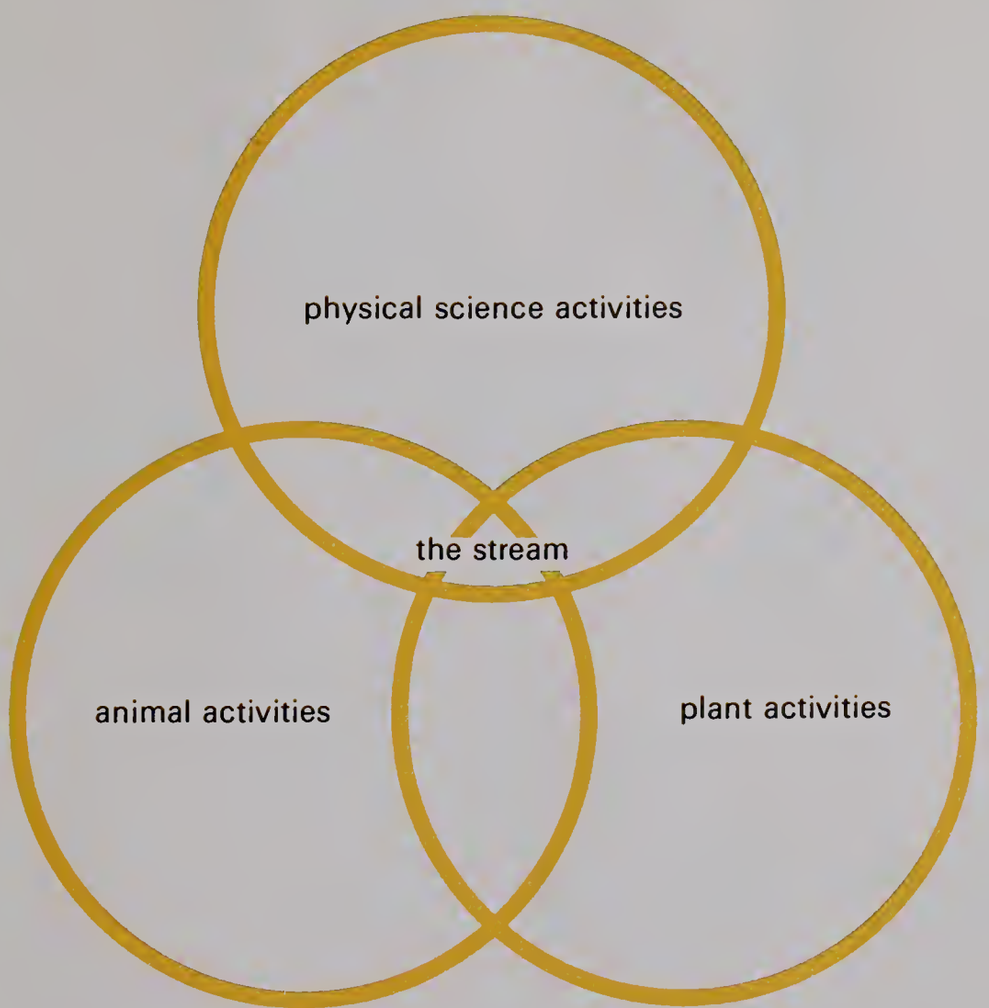
PHYSICAL FACTORS



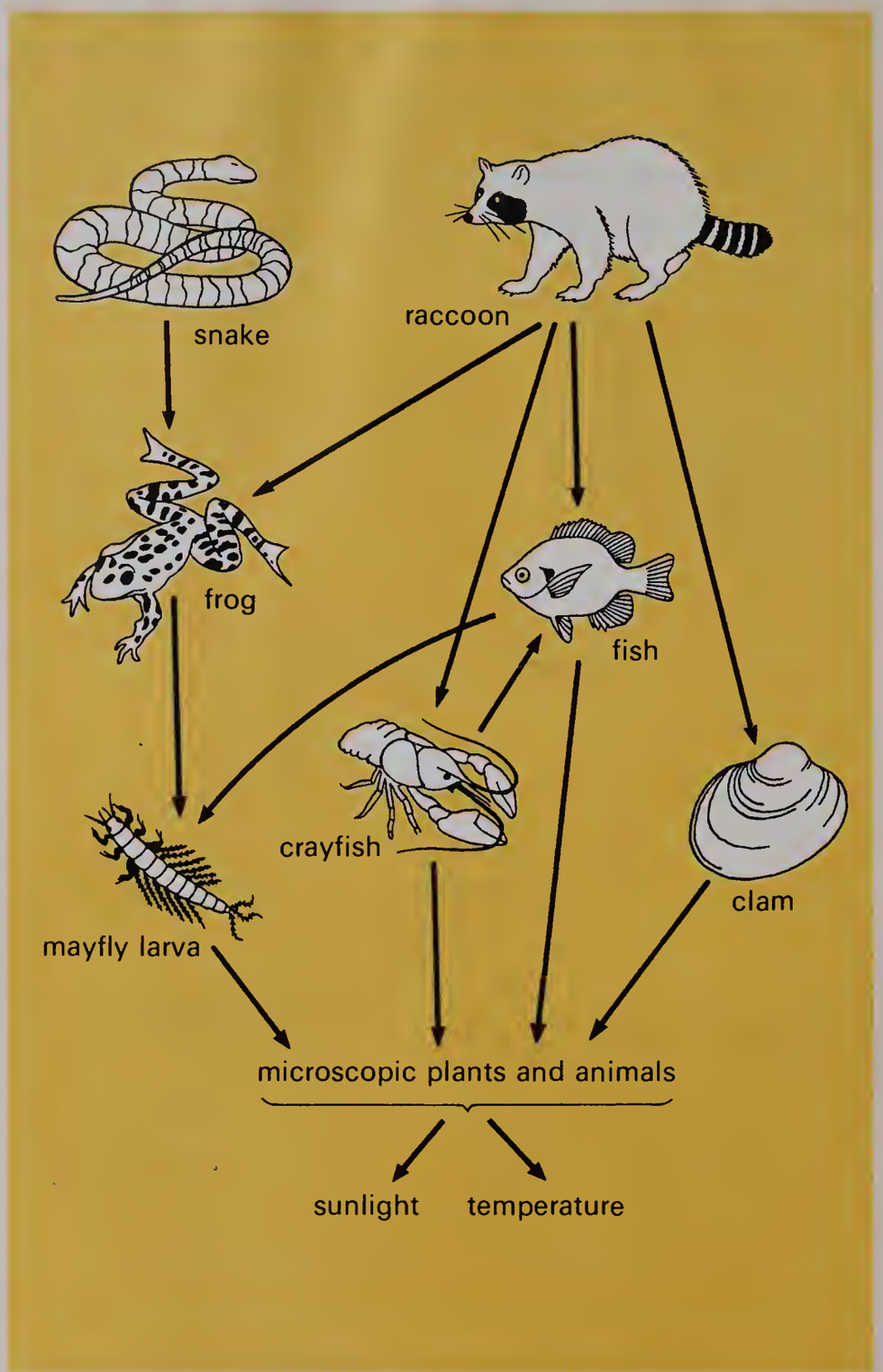
How does man pollute the stream community?

INTERDEPENDENCE

Although the three charts are presented separately, you will very quickly observe that the physical environment, animal and plant life in a stream are related to one another. For example, a certain animal may depend upon a type of plant for its food. The plant in turn may rely upon the type of stream bottom for its growth. The kind of bottom is partly determined by the stream flow.



The following diagram is a [illegible] ple of inter-dependence in the stream community.



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